Digitized by the Internet Archive
in 2025

https://archive.org/details/bulletin-maine-agricultural-and-forest-experiment-station_1888-1909_1-39

I. B.
E.

IMP. BUR. ENTOM.
— LIBRARY —
No. 189.

[382-5-10]

University of Maine

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.
CHAS. D. WOODS, Director

ENTOMOLOGICAL PAPERS FROM THE MAINE AGRICULTURAL EXPERIMENT STATION.

NOS. 1-40. 1888-1909.

Ent. 1. Report of the Me. Agric. Exp. Sta. for 1888. pp. 136-189. 95

REPORT OF BOTANIST AND ENTOMOLOGIST. By F. L. Harvey.

Saperda candida, Round Headed Apple Tree Borer. pp. 153-155, Fig. 1.

Chrysobothris femorata, Flat Headed Apple Tree Borer. pp. 155-157, Figs. 2, 3.

Mytilaspis pomorum, Oyster Shell Bark Louse. pp. 157-159, Figs. 4-7.

Clisiocampa americana, Apple Tree Tent Caterpillar. pp. 159-164, Figs. 8-16.

Clisiocampa sylvatica, Forest Tent Caterpillar. pp. 164-166. Figs. 17, 18.

Anisopteryx pometaria, Fall Canker Worm. pp. 166-169. Figs. 19, 20.

Tmetocera ocellana, Eye Spotted Bud Moth. pp. 169-170. Fig. 21.

Aphis mali, Apple Tree Aphis. pp. 170-172. Figs. 22, 23.

Carpocapsa pomonella, Codling Moth. pp. 172-174. Fig. 24.

Trypeta pomonella, The Apple Maggot. pp. 175-176. Fig. 25.

Lithophane autennata, Ash Gray Pinion. pp. 176. Fig. 26.

Selandria cerasi, The Pear Tree Slug. pp. 176-178. Figs. 27, 28.

Conotrachelus nenuphar, Plum curculio. pp. 178-181. Fig. 29.

Myzus cerasi, Cherry Tree Plant Louse. pp. 181-182.

Nematus ventricosus, Imported Currant Worm. pp. 182-184. Figs. 30, 33.

Aspidiotus nerii, The White Scale. pp. 184-185. Fig. 34.
Papilio asterias, Black Swallow-tail. pp. 186-187.
Alaus oculatus, Eyed Elater. p. 187.
Corythuca arcuta, Hawthorn Tingis. p. 187.
Vanessa antiopa, Mourning Cloak Butterfly. pp. 187-188.
Tenebrio molitor, The Meal Worm. p. 189.

Ent. 2. Report of the Me. Agric. Exp. Sta. for 1889. pp. 148-256.
REPORT OF THE BOTANIST AND ENTOMOLOGIST. By F. L. Harvey.
Forest Tent Caterpillar. p. 188.
Codling Moth. p. 188.
Fall Canker Worm. p. 189.
White Marked Tussock Moth. p. 189.
May Beetle. p. 189 (mention).
Apple maggot, Trypeta pomonella. pp. 190-237, Plates I-III. 17 figs.
Drosophila ampelophila, Vine-loving Pomace Fly. Plate IV.
Insecticides. pp. 242-254.

Ent. 3. APPLE MAGGOT, Trypeta pomonella, Monograph. By F. L. Harvey. pp. 1-49, 4 pls., 26 figs. Out of print. See Ent. 2 *

Ent. 4. Report of the Me. Agric. Exp. Sta. for 1890. pp. 105-139.
REPORT OF THE BOTANIST AND ENTOMOLOGIST. By F. L. Harvey.
Platysamia cecropia, Cecropia Emperor Moth. pp. 121-122.
Orgyia leucostigma, The White-marked Tussock Moth. pp. 122-124, Figs. 1-4.
Hyphantria cunea, Fall Web-worm. pp. 124-127. Figs, 5, 6.
Tmetocera ocellana, The Eye-spotted Bud-moth. pp. 128-131. Fig. 7.
Schizoneura lanigera, The Woolly louse of the Apple. pp. 131-134. Figs. 8-10.
Oedemasia concinna, The Red Humped Apple-tree Caterpillar. pp. 135-137. Figs. 11-13.
Anisopteryx pometaria, The Fall Canker-worm. pp. 137-138.
Clisiocampa sylvatica, Forest Tent-caterpillar. pp. 138-139.

Ent. 5. Bulletin Me. Agr. Exp. Sta. No. 2. 1890. By F. L. Harvey.
APPLE MAGGOT, Trypeta pomonella. pp. 1-5. Out of print. See Ent. 2. 9

Ent. 6. Report Me. Agr. Exp. Sta. for 1891. pp. 175-207. REPORT OF BOTANIST AND ENTOMOLOGIST. By F. L. Harvey.
Ixodes ricinus, Ticks. pp. 187.
Sphinx or Hawk Moths. pp. 187-188.
Cut-worms. pp. 189-190.
Agrostis saucia, Variegated Cut-worm. p. 192. Figs 1-4.
Hadena devastatrix, Glassy Cut-worm. p. 193. Figs. 5-6.
Agrostis Ypsilon, Greasy Cut-worm. pp. 194-198. Fig. 7.
Apatela lepusculina, Cotton-wood Dagger. pp. 198-199. Fig. 8.
Aphonus tridentatus, Three-toothed Aphonus. pp. 199-202. Fig. 9.

Dytiscus verticalis, Predacious Water Beetle. pp. 202-203.
Elaphidion parallelum, Parallel Elaphidion. pp. 203-204. Fig. 10.
Ptinus brunneus, Brown Ptinus. pp. 204-205. Fig. 11.
Cotalpa lanigera, Goldsmith Beetle. pp. 205-206. Figs. 12, 13.
Remedies for Borers. pp. 206-207.

Ent. 7. Report of Me. Agr. Exp. Sta. for 1892. pp. 99-146. REPORT OF BOTANIST AND ENTOMOLOGIST. By F. L. Harvey.
Anisopteryx pometaria, Fall Canker-worm. pp. 117-119. Fig. 3.
Heliothis armigera, Boll-worm or Corn-worm. pp. 119-123. Fig. 4.
Blissus leucopterus, Chinch Bug. pp. 124-130. Figs. 5, 6.
Haematobia serrata, Horn Fly. pp. 131-132. Pl. II. 3 figs.
Tetranychus 2-maculatus, n. sp., Two-spotted Mite. pp. 133-146. Pl. III. 4 figs.

Ent. 8. Report Me. Agr. Exp. Sta. for 1893. pp. 145-180. REPORT OF BOTANIST AND ENTOMOLOGIST. By F. L. Harvey.
Gelechia cerealella, Angoumois Grain Moth. pp. 159-161. Figs. 5, 6.
Hybernia tiliaria, Lime Tree Winter Moth. pp. 161-163. Fig. 7.
Bucculatrix pomifoliella, Apple Leaf Bucculatrix. pp. 164-166. Fig. 8.
Limenitis disippus, Disippus Butterfly. pp. 166-167. Figs. 9, 10.
Lachnosterna fusca, May Beetle. pp. 167-171. Fig. 11.
Bruchus obtectus, Bean Weevil. pp. 171-176. Figs. 12-15 (Pea weevil, Fig. 16).
Xyleborus pyri, Pear Blight Beetle or Shot Borer. pp. 176-177. Fig. 17.
Psila rosae, Carrot Fly. pp. 178-180. Figs. 18-21.

Ent. 9. Report Me. Agr. Exp. Sta. for 1894. pp. 81-123. REPORT OF BOTANIST AND ENTOMOLOGIST. By F. L. Harvey.
Achorutes nivicola, Snow Flea. p. 104.
Lepisma saccharina, Silver Fish. pp. 105-106. Fig. 5.
Perillus circumcinctus, Ring Banded Soldier Bug. pp. 106-107. Fig. 6.
Lecanium caryae, var. Canadense, Elm Tree Bark Louse. pp. 107-109.
Myzus ribis, Gooseberry Plant Louse. p. 109.
Cacoecia rosaceana, Oblique Banded Leaf Roller. p. 110, Figs. 7, 8.
Platysamia cecropia, Cecropia Emperor Moth. p. 111, 1 pl., 3 figs.
Blissus leucopterus, Chinch Bug. pp. 111-114. Figs. 13, 14.
Anthrenus scrophulariae, Buffalo Carpet Beetle. pp. 115-121. Fig. 10.

Magdalis olyra, Oak Bark Weevil. p. 122. Figs. 11, 12.
Anisopteryx pometaria, Fall Canker Worm. p. 123.

Ent. 10. Report Me. Agr. Exp. Sta. for 1895. pp. 88-124. REPORT OF BOTANIST AND ENTOMOLOGIST. By F. L. Harvey.
Cattle Lice. p. 98.
Haematopinus eurysternus, Short-nosed Ox Louse. pp. 99-100. Fig. 1.
Haematopinus vituli, Long-nosed Ox Louse. pp. 100-101. Fig. 2.
Trichodectes scalaris, Biting Louse of Cattle. pp. 101-103. Fig. 3.
Eggs of the Long-nosed Ox Louse. pp. 103-104. Fig. 4.
Spilosoma virginica, Yellow Woolly-bear. pp. 104-105. Fig. 5.
Tinea tapetzella, Tapestry Moth. p. 105.
Typophorus canellus, var. gilvipes, Spotted Paria Strawberry Leaf Beetle. pp. 106-110. Fig. 6.
Crepidodera cucumeris. Cucumber Flea Beetle. pp. 110-111. Fig. 7.
Epochra canadensis, The Currant Fly. pp. 111-124, 2 pl., 12 figs.

Ent. 11. Report Me. Agr. Exp. Sta. for 1896. pp. 117-126. NOTES ON INSECTS OF THE YEAR. By F. L. Harvey.
Wood Louse. p. 117.
Croton Bugs. p. 117.
Oyster Shell Bark Louse. p. 117.
Hemispherical Scale. p. 118.
Elm-tree Bark Louse and other Elm insects. p. 118.
Buffalo Tree Hopper. p. 118. 1 fig.
Yellow-necked Apple-tree Caterpillar. p. 118. 1 fig.
Fall Canker-worm. p. 118.
Currant Span Worm. p. 119. 1 fig.
Gooseberry Fruit Worm. p. 119. 2 figs.
Lime Tree Winter Moth. p. 119.
Army Worm. p. 119.
Ash Gray Pinion. pp. 119-120.
Velleda Lappet Moth. p. 120. Figs. 6, 7.
Apple-tree Tent Caterpillar. p. 120.
Currant Fly, Epochra canadensis. p. 120.
Apple Maggot, Trypeta pomonella. p. 120.
Rat-tailed Larva. p. 121.
Horn Fly. p. 121.
Buffalo Beetle. p. 121.
Pigeon Tremex. p. 121.
Ptinus fur. p. 121.
Insects examined in 1896 pp. 122-123.
Smynthurus albamaculata, n. sp., A New Garden Smynthurid, pp. 124-126, 1 pl., 5 figs.

Ent. 12. The Currant Fly, Epochra canadensis, a Monograph. By F. L. Harvey. 1896. pp. 1-14, 2 pls. 12 figs. Out of print. See Ent. 13. *

Ent. 13. Bulletin Me. Agr. Exp. Sta. No. 35. May 1897. (Also Report of Me. Agr. Exp. Sta. for 1897, pp. 25-31).
The Currant Fly, Epochra canadensis. By F. L. Harvey. pp. 3-8, 1 pl., 10 figs.

Ent. 14. Report of Me. Agr. Exp. Sta. for 1897. pp. 173-178. Notes on Insects of the Year. By F. L. Harvey.
Stone Flies. p. 173. Figs. 1, 2.
Cockscomb Gall. p. 173. (Mere mention).
Mamestra picta, Zebra Caterpillar. p. 173, Fig. 3.
Gortyna nitela, Potato Stalk Borer. p. 173.
Apple Tree Tent Caterpillar. pp. 173, 174.
Forest Tent Caterpillar. pp. 173, 174.
Beech Bud Insect. pp. 174-175.
Brown-tail Moth. p. 175.
Sciara inconstans, Fickle Midge. pp. 175-176.
Anthomyiids. p. 176.
Trypeta pomonella, Rail-road Worm. p. 176.
Epochra canadensis, Currant Fly. p. 176.
Calandra oryzae, Rice Weevil. p. 176. Figs. 4, 5.
Spotted Paria. p. 176.
Dendroctonus rufipennis. p. 176.
Insects examined in 1897. pp. 177, 178.

Ent. 15. Report Me. Agr. Exp. Sta. for 1898. pp. 118-130.
Injurious millipedes. By F. L. Harvey. pp. 118-121.
Polydesmus moniliaris. p. 119. Fig. 1 and Fig. 5.
Iulus hortensis. p. 119, Fig. 2.
Iulus virgatus. pp. 119-120.
Paraiulus immaculatus. p. 120.
Orthomorpha gracilis. p. 120. Figs 3-4.
Limnephilus sp., An Injurious Caddice-Fly. By F. L. Harvey. pp. 122-124. Figs. 6, 7.

Ent. 16. Insects of the Year. By F. L. Harvey. pp. 125-130.
Haematopinus eurysternus, Short-nosed Ox Louse. p. 125.
Diapheromera femorata, Walking Stick. p. 125.
Aphis mali, Apple Tree Aphis. p. 125.
Caddice Fly. p. 125.
Bud Moths. p. 125.
Oedemasia concinna, Red-humped Apple Worm. p. 126.
Fall Canker Worm. p. 126.
Mamestra picta, Zebra Caterpillar. p. 126.
Clisiocampa americana. p. 126.
Brown-tail Moth. p. 126.
Chrysanthemum Fly. p. 127.
Trypeta pomonella, Apple Maggot. p. 127.
Epochra canadensis, Currant Fly. p. 127.
Sciara inconstans, Fickle Midge. p. 127.

Anthrenus scrophulariae, Buffalo Carpet Beetle. pp. 127-128.
Lachnosterna fusca, May Beetle. p. 128.
Diabrotica vittata, Cucumber Beetle. p. 128.
Gortyna nitela, Potato Stalk Borer. p. 128.
Oberea bimaculata, Blackberry Cane Borer. p. 128.
Anthonomus signatus, Strawberry Weevil. p. 128.
Eriocampa cerasi, Pear Tree Slug. p. 128.
Insects examined in 1898. pp. 129, 130.

Ent. 17. Bulletin Me. Agr. Exp. Sta. No. 56. December, 1899. (Also in Report Me. Agr. Exp. Sta. for 1899. pp. 107-144).
Apple Insects of Maine. By F. L. Harvey and W. M. Munson. pp. 107-144. 8 plates, 33 figs.
Saperda candida, Round Headed Apple Tree Borer. pp. 108-109, 1 pl., fig. 1.
Chrysobothris femorata, Flat Headed Apple Tree Borer. pp. 109-110, 1 pl., 1 fig.
Mytilaspis pomorum, Oyster Shell Bark Louse. pp. 110-111, 1 pl., 2 fig.
Xyleborus pyri *or* dispar, Pear Blight Beetle. pp. 112-113, 1 pl., 2 figs.
Schizoneura lanigera, Woolly Louse of the Apple, pp. 113-114, 1 pl., 1 fig.
Tmetocera ocellana Bud Moth. pp. 114-115. 1 fig.
Cacoecia rosana, Oblique Banded Leaf Roller. p. 116, 2 figs.
Teras minuta, Lesser Apple Leaf Folder. pp. 117-118, 1 fig.
Clisiocampa disstria, Forest Tent Caterpillar. pp. 118-120, 1 fig.
Clisiocampa americana, Apple Tree Tent Caterpillar. pp. 120-121, 1 fig.
Hyphantria cunea, Fall Web Worm. pp. 121-123, 2 figs.
Hybernia tiliaria, Lime Tree Winter Moth. pp. 123-124, 1 fig.
Bucculatrix pomifoliella, Apple Leaf Bucculatrix. pp. 125-126, 1 fig.
Orgyia (Notolophus) leucostigma, White-marked Tussock Moth. pp. 126-128, 1 fig.
Anisopteryx pometaria, Fall Canker Worm. pp. 128-129, 2 figs.
Aphis mali, Apple Tree Aphis. pp. 129-130, 1 fig.
Oedemasia concinna, Red Humped Apple Tree Caterpillar pp. 130-132.
Platysamia cecropia, Cecropia Emperor Moth. pp. 132-133.
Carpocapsa pomonella, Codling Moth. pp. 133-134, 1 fig.
Conotrachelus nenuphar, Plum Curculio. pp. 134-136, 1 fig.
Trypeta (Rhagoletis) pomonella, Apple Maggot. pp. 136-140, 3 figs.

Ent. 18. Bulletin Me. Agr. Exp. Sta. No. 61. Notes on Insects and Plants, March 1900, pp. 31-44. Also Report Me. Agr. Exp. Sta. for 1900, pp. 31-44. By F. L. Harvey (1899).
Blissus leucopterus, Chinch Bug. p. 31.
Nectarophora destructor, Destructive Pea Louse. p. 31.
Aphis gossypii, Cucumber Plant Louse. p. 31.
Aphis maidis, The Corn Louse. p. 31.
Corydalis cornuta, Dobson Fly or Helgramite. p. 31.
Teras minuta, The Lesser Leaf Roller. p. 32.
Cacoecia rosana, Oblique-banded Leaf Roller. p. 32.
Schizoneura americana, American Elm Plant Louse. p. 32. Photo of leaf curl.
Tmetocera ocellana, Eye-spotted Bud Moth. p. 32. Photo of work.
Cacoecia cerasivorana, Cherry-tree Ugly Nest. p. 32-33.
Bucculatrix pomifoliella, Apple Bucculatrix, p. 33.
Arctia americana, American Tiger Moth. p. 33.
Sphingidae, Sphinx Moths. p. 33.
Gortyna nitela, The Stalk Borer. p. 33.
Cecropia, Promethea and Polyphemus Moths. p. 33.
Velleda Lappet Moth. p. 33.
Forest Tent Caterpillar. pp. 33-34.
Fall Canker Worm. p. 34.
Anosia plexippus, Monarch Butterfly. p. 34.
Mourning Cloak Butterfly. p. 34.
Eristalis tenax, Drone Fly. p. 34.
Pegomyia vicina, Anthomyiid Flies. p. 34.
Epochra canadensis, Currant Fruit Fly. p. 34.
Buffalo Carpet Beetle. p. 35.
Ips fasciatus, Striped Sap Beetle. p. 35.
May Beetle. p. 35.
Adimonia cavicollis, Cherry Leaf Beetle. p. 35.
Bean Weevils. p. 35.
Larrid Bees. pp. 35-36.
Euproctis chrysorrhoea, Brown-tail Moth. pp. 36-39.
Insects Examined in 1899, pp. 40-41.

Ent. 19. Bulletin Me. Agr. Exp. Sta. No. 83. June 1902. (Also Report of Me. Agr. Exp. Sta. for 1902. pp. 97-128). (Also Agric. of Me., 1st Annual Report of Commissioner of Agric., 1902. pp. 51-82).
The Grass Thrips, Anaphothrips striata. By Lewis R. Cary. pp. 97-128, 7 pl., 16 figs.

Ent. 20. Bulletin Me. Agr. Exp. Sta. No. 91. April 1903. (Also Report of Me. Agric. Exp. Sta. for 1903, pp. 41-52; also Agric. of Me. Report of Commissioner of Agric., 1903. pp. 27-38).
The Chinch Bug in Maine. Blissus leucopterus. By H. W. Britcher. pp. 41-52, figs. 11, 12.

20a. Bulletin Me. Agr. Exp. Sta. No. 95. Sept. 1903. (Also Report of Me. Agr. Exp. Sta. 1903, 121-124; also Agric. of Maine, Report of Commissioner of Agriculture, 1903. pp. 79-82).

CANKER WORMS. By W. M. Munson.

Paleacrita vernata, Spring Canker Worm. pp. 121, 122.

Alsophila pometaria, Fall Canker Worm. pp. 122, 123. Figs. 39, 40.

Ent. 21. Bulletin Me. Agr. Exp. Sta. No. 96. October 1903. (Also Report of Me. Agr. Exp. Sta. for 1903. pp. 125-144; also Agric. of Me. Report of Commissioner of Agric. for 1903. pp. 83-102).

PLANT HOUSE ALEYRODES, Aleyrodes vaporariorum. By Lewis R. Cary. pp. 125-144, figs. 41 to 51.

Ent. 22. Bulletin Me. Agr. Exp. Sta. No. 108. November 1904. (Also Report Me. Agr. Exp. Sta. for 1904, pp. 153-168; also 3rd Annual Report of the Commissioner of Agriculture of the State of Me. 1904 (1905) pp. 121-139).

BROWN-TAIL MOTH AND OTHER ORCHARD MOTHS. By Edith M. Patch. pp. 153-168. Figs. 19-27.

Euproctis chrysorrhoea, Brown-tail Moth. pp. 154-161. 2 Figs.

Porthetria dispar, Gypsy Moth. pp. 161-162.

Clisiocampa americana, Orchard Tent Caterpillar. pp. 162-163.

Clisiocampa disstria, Forest Tent Caterpillar. pp. 162-163.

Hyphantria cunea, Fall Web-worm. p. 163.

Notolophus (Orgyia) leucostigma, White-marked Tussock Moth. p. 164.

Notolophus antiqua, Old Tussock Moth. p. 164. 2 figs.

Notolophus definata, Well-marked Tussock Moth. p. 164.

Halisidota caryae, Hickory Tiger Moth. pp. 164-165, 1 fig.

Oedemasia concinna, Red-humped Caterpillar. p. 164-165, 1 fig.

Callosamia promethea, Promethea Moth. pp. 165-168.

Samia cecropia, Cecropia Moth. pp. 165-168, 1 fig.

Ent. 23. Bulletin Me. Agr. Exp. Sta. No. 109. December 1904. (Also Report Me. Agr. Exp. Sta. for 1904, pp. 169-184; also Agric. of Me. Report of Commissioner of Agric. for 1904, pp. 140-158).

THE APPLE MAGGOT, Rhagoletis pomonella. By Edith M. Patch and W. M. Munson. pp. 169-178, 1 pl. 5 figs.

INSECT NOTES FOR 1904. By Edith M. Patch. pp. 179-184, 2 pl.

Euproctis chrysorrhoea, Brown-tail Moth. p. 179.

Notolphus leucostigma, White Marked Tussock Moth. p. 179.

Oedemasia concinna, Red-humped Caterpillar. p. 179.

Eriopeltis festucae, Cottony Grass Scale. p. 179.
Schizoneura tessellata, Alder Blight. p. 179, 1 fig.
Chermes pinicorticis. p. 179, 1 fig.
Lampyridae, Fire Flies. p. 179.
Chrysopidae, Lace Winged Flies, p. 179, 2 figs.
Eristalis tenax, Drone Fly. p. 180, 1 fig.
Cecidomyia strobiloides, Willow Cone Gall. p. 180, 2 figs.
Asilidae, Robber Flies. p. 180, 1 fig.
Plagionotus speciosus, Beautiful Maple Borer. p. 181, 1 fig.
Insects received for identification. pp. 181-184.

Ent. 24. Bulletin Me. Agr. Exp. Sta. No. 121. December 1905. (Also Report Me. Agr. Exp. Sta. for 1905, pp. 169-180; also Agric. of Me. 4th Report Comm. of Agric. for 1905. pp. 88-100).

THE COTTONY GRASS SCALE, Eriopeltis festucae. By Edith M. Patch. pp. 169-180, 2 pl., 1-8 figs.

Ent. 25. Bulletin Me. Agr. Exp. Sta. No. 123. December 1905. (Also Report Me. Agr. Exp. Sta. for 1905, pp. 205-228; also Agric. of Me. 4th Report Comm. of Agric. for 1905, pp. 157-180).

STRAWBERRY CROWN GIRDLER, Otiorhynchus ovatus. By Edith M. Patch. pp. 205-212, figs. 11, 12, 13.

INSECTS OF THE YEAR (1905). By Edith M. Patch. pp. 213-228. Figs. 14-21.

Notolophus leucostigma, Notolophus antiqua, Tussock Moths. p. 213, 2 figs.
Oedemasia concinna, Red-humped Caterpillar. p. 213, 1 fig.
Datana ministra, Yellow Necked Caterpillar. p. 214, 1 fig.
Clisiocampa americana, Tent Caterpillar. p. 214.
Papaipema nitela, Stalk borer. p. 214.
Cacoecia cerasivorana, Cherry Tortrix. p. 214.
Euvanessa antiopa, Mourning Cloak. p. 214, 1 fig.
Cingilia catenaria, Dotted Geometer. p. 215, 1 fig.
Sciaphilus asperatus, Snout Beetle. p. 215-217, 1 fig.
Anthrenus scrophulariae, Carpet Beetle. p. 217.
Epitrix cucumeris, Flea Beetle. p. 217.
Wire-worms. pp. 217-219.
Tarnished Plant Bug. pp. 219-220.
Plant-lice. p. 220.
Smynthurus albamaculata, Garden Flea. pp. 220-221.
Apple Maggot. p. 221.
Brown-tail Moth. pp. 221-223.
List of Insects received for identification. pp. 223-228.

Ent. 26. Bulletin Me. Agr. Exp. Sta. No. 134. December 1906. (Also Report Me. Agr. Exp. Sta. for 1906, pp. 209-228. Also Agric. of Me. 5th Report of Comm. of Agric. for 1906. pp. 128-153).

INSECT NOTES FOR 1906. By Edith M. Patch. pp. 209-228. figs. 16-23.

Brown-tail Moth. pp. 209-213, 1 pl., 2 figs.
Gypsy Moth. p. 213.
Colorado Potato Beetle. pp. 213-214.
Epitrix cucumeris, Tomato Flea Beetle. p. 214.
Systena hudsonias, Smartweed Flea Beetle. p. 214.
Cosmopepla carnifex. p. 214.
Pentatoma juniperina. p. 214.
Lygus pratensis, Tarnished Plant Bug. pp. 214-215.
Nectarophora solanifolii. pp. 215-216.
Aphis sp. (On Potato) p. 216.
Pemphigus tessellata, Alder Blight. p. 216.
Syrphus Maggots. p. 217.
Feniseca tarquinius, The Harvester. pp. 217-218, 1 pl., 3 figs.
Lasius mixtus. p. 218.
Coleophora laricella, Larch Case Bearer. pp. 218-220.
Teras minuta, Yellowhead Cranberry Worm. p. 220.
Rhagoletis (Trypeta) pomonella, Apple Maggot. p. 221.
Carpocapsa pomonella, Codling Moth. pp. 221-222.
Corythuca pergandei. p. 222.
Pinipestis sp. in spruce cones. p. 222.
Drosophila amoena. p. 222.
Tibicen rimosa, Harvest Fly. pp. 222-223, 1 fig.
Plutella cruciferarum, Diamond-Back Moth. p. 223-224.
Datana ministra, Yellow-necked Caterpillar. p. 224.
Oedemasia concinna, Red-humped Caterpillar. p. 224.
Tmetocera ocellana, The Bud Moth. p. 224.
Notolophus leucostigma, Tussock Moth. p. 224.
Notolophus antiqua, Tussock Moth. p. 224.
Limneria guignardi. p. 224, 1 fig.
Euvanessa antiopa, Yellow Edge Butterfly. pp. 224-225.
Smynthurus albamaculata, Garden Flea. p. 225.
Mosquitoes. p. 225.
Anopheles punctipennis.
Anopheles quadrimaculatus.
Aedes fuscus.
Aedes canadensis.
Aedes sylvestris.
Aedes sollicitans.
Aedes abfitchii.
Insects Received for Identification. pp. 226-228.

Ent. 27. Bulletin Me. Agr. Exp. Sta. No. 147. November 1906. (Also Report Me. Agr. Exp. Sta. for 1906. pp. 235-257).
Potato Plant Louse, Nectarophora solanifolii. By Edith M. Patch. pp. 235-257, figs. 25-33.

Ent. 28. Bulletin Me. Agr. Exp. Sta. No. 148. November 1907. (Also Report Me. Agr. Exp. Sta. for 1907. pp. 259-286).
Insect Notes for 1907. By Edith M. Patch, pp. 259-286, figs. 34-44.

Brown-tail Moth. pp. 261-262.
Gypsy Moth. pp. 261-262.
Heterocampa guttivitta. p. 262, 5 figs.
Calosoma calidum. p. 262.
Podisus modestus. pp. 262-263, 1 fig.
Dryocampa rubicunda. p. 263, 1 fig.
Clisiocampa disstria, Forest Tent Caterpillar. p. 263.
Clisiocampa americana, Orchard Tent Caterpillar. p. 264.
Archips (Cacoecia) cerasivorans, Cherry Tree Tortrix. pp. 264-265.
Orchard Insects in Maine. pp. 265-269, 1 fig.
Grasshoppers.
Melanoplus femur-rubrum. p. 269.
Dissosteira carolina. pp. 269-270.
Fungus Attack. p. 270.
Brachys aerosa. p. 270.
Anthonomus signatus, Strawberry Weevil. pp. 270-271.
Macrodactylus subspinosus, Rose Chafer. p. 271.
Diabrotica vittata, Striped Cucumber Beetle. pp. 271-272.
Macrops vitticollis. p. 272.
Nematus erichsonii, Larch Sawfly. p. 272. (Birch misprint for larch).
Craesus latitarsus. p. 272.
Lophyrus abietis, Fir Tree Sawfly. p. 272.
An Ant Attack on Plant Lice. pp. 272-273.
Nectarophora solanifolii, Potato Plant Louse. p. 273.
Lygus pratensis, Tarnished Plant Bug. p. 273.
Predaceous Beetles and Hibernating Insects. pp. 273-274.
Test with a lot of 22 Ground Beetles. p. 274.
Test with a lot of 8 Ground Beetles. p. 275.
Test with Rove Beetles on Staphylinids. pp. 275-276.
Cosmopepla carnifex. p. 276.
Euchistus tristigma. pp. 276-277, 1 fig.
Podisus modestus. p. 277.
Grasshoppers. p. 277.
Macrobasis unicolor, Gray Blister Beetle. p. 277.
Epicauta pennsylvanica, Black Blister Beetle. pp. 277-278.
Meloe angusticollis, Oil Beetle. p. 278.
Gall Insects. pp. 278-279.

Ent. 29. CROCIGRAPHA NORMANI. By Edith M. Patch. Ent. News, July 1908. (Description of larva). pp. 321-322, Plate XIII.

Ent. 30. PEMPHIGUS TESSELLATA, Alternate Hosts, Migrants and True Sexes. By Edith M. Patch. Ent News. December 1908. pp. 484-488. Plate XXIV.

Ent. 31. Bulletin Me. Agr. Exp. Sta. No. 161. November 1908. (Also Report Me. Agr. Exp. Sta. for 1908. pp. 311-350)
THE SADDLED PROMINENT, Heterocampa guttivitta. By Edith M. Patch. pp. 311-350, figs. 14-40.

Ent. 32. Bulletin Me. Agr. Exp. Sta. No. 162. December 1908. (Also Report Me. Agr. Exp. Sta. for 1908. pp. 351-386).

INSECT NOTES FOR 1908. By Edith M. Patch. pp. 351-386, figs. 41-58.

Brown-tail Moth. p. 352.

Gypsy Moth. p. 352.

Heterocampa guttivitta, Saddled Prominent. p. 353.

Anisota virginiensis, (pellucida), Rosy Striped Oak Worm. p. 353, 3 figs.

Anisota (Dryocampa) rubicunda, Green Striped Maple Worm. p. 354.

Symmerista (Edema) albifrons, White Tipped Moth. p. 354.

Argyroploce abietana Fernald, A New Spruce Tortrix. p. 355, 3 figs.

Crocigrapha normani, A New Noctuid for the Apple, p. 356.

Acrobasis (Phycis) rubrifasciella. p. 356.

Deilephila gallii. pp. 356-357, 4 figs.

Datana major. p. 357.

Ogdoconta cinereola ? Bean Worm. p. 358.

Alcothoe caudata, Clear Winged Moths. p. 358.

Estigmene acraea. p. 358.

Diacrisia (Spilosoma) virginica. p. 358.

Basilona imperialis, The Imperial Moth. p. 358, 1 fig.

Lapara bombycoides, Pine Hawk Moth. p. 358, 1 fig.

Dibolia borealis, Plantain Flea Beetle. p. 359, 1 fig.

Oberea bimaculata, Raspberry Cane Borer. pp. 359-361, 1 fig.

Osmoderma scabra, Rough Flower Beetle. p. 361, 3 figs.

Dermestes vulpinus. pp. 361-362.

Corticaria ferruginea, Gyle. p. 362.

Brachys aerosa. p. 362.

Dendroctonus terebrans, Turpentine Bark Beetle. p. 362.

Monohammus titillator, Pine Borer. p. 362.

Monohammus scutellatus, Pine Borer. p. 362.

Cryptorhynchus lapathi, Poplar or Willow Borer. p 363.

Conotrachelus nenuphar, Plum Curculio. p. 363.

Aphrophora parallela, Parallel Spittle Insect. p. 363.

Eriopeltis festucae, Cottony Grass Scale. p. 363.

Leptoterna dolobrata. p. 363.

Canthophorus cinctus. p. 363.

Anasa tristis, Squash bug. p. 364.

Lygus pratensis, Tarnished Plant Bug. p. 364.

Podisus modestus. p. 364.

Aphididae. p. 364.

Nematus erichsonii, Larch Sawfly. p. 364.

Lophyrus abietis, Spruce Sawfly. p. 364.

Tiphia inornata. p. 365.

Chelonus sp. p. 365.

Ichneumon sublatus. p. 365.
Pimpla pedalis. p. 365.
Grasshoppers. pp. 365-366.
Fungus Diseases of Insects. p. 366.
White Pine Blight. pp. 361-367.
Eriophyes fraxiniphila Hodgkiss, Ash Clusters and Gall Mites. pp. 367-368, 1 fig.
Eriophyes fraxini (Karp.) Ash Clusters and Gall Mites. pp. 367-368.

† Ent. 33. Homologies of the Wing Veins of the Aphididae, Psyllidae, Aleurodidae, and Coccidae. By Edith M. Patch. Annals of the Entomological Society of America. Vol. II, No. 2. June 1909. pp. 101-135. 46 figures.

Ent. 34. Pemphigus venafuscus n. sp. By Edith M. Patch. Ent. News. July 1909. Vol. XX, pp. 319-322. Plate XVII, 7 figures.

Ent. 35. The Desmodium Aphid, Microparsus variabilis, n. g. n. sp. By Edith M. Patch, Ent. News. October 1909 Vol. XX. pp. 337-341. Plates XVIII, XIX.

Ent. 36. Downy Psyllid of Alder, Psylla floccosa n. sp. By Edith M. Patch. Canadian Entomologist. Sept. 1909, Vol. XLI, No. 9. pp. 301-303. Plate 9, 17 figures.

Ent. 37. Bulletin Me. Agr. Exp. Sta. No. 171. The Pine leaf Chermes and the Green winged Chermes. By Edith M. Patch. November, 1909. pp. 201-208. Economic treatment of *Chermes pinifoliae* Fitch and *Chermes abietis* Linn. Figs. 43-45.

Ent. 38. Bulletin Me. Agr. Exp. Sta. No. 172. (Also Report Me. Agr. Exp. Sta. for 1909, pp. 209-276).
Fungus Gnats. (The Mycetophilidae of North America). By O. A. Johannsen.

Part I. With tables to subfamilies, genera and species. Introduction; characters; habits and economic relations; remedial measures. Three plates with 62 figures.

Bolitophilinae 217, Bolitophila 218, B. disjuncta 218, B. cinerea 219, B. hybrida 219, B. montana 220, Hesperinus 220, H. brevifrons 221, Mycetophaetus 222, Mycetobiinae 222, Mycetobia 223, M. divergens 223, Palaeoplatyura 224, P. aldrichii 225, P. johnsoni 226, Ditomyia 227, D. euzona 227, Symmerus 228, S. tristis 229, S. lenis 229, S. bifasciata, 229, S. mexicana 230, S. annulata 231, S. lauta 231, Diadocidinae 231, Diadocidia 231, D. borealis 233, D. terricola 232, ferruginosa 232, Ceroplatinae 233, Asindulum 234, A montanum 234, A. coxale 234, A. flavum 235, Ceroplatus 235, C. carbonarius 236, C. terminalis, 236, C. clausus 237, C. militaris 237, Cerotelion 238, C. apicalis 239, C. bellulus 239, C. longimanus 240, Hesperodes 241, H. johnsoni 241, Apemon 241, A. gracilis 243, A. pectoralis 243, A. maudae 244, A.

pulchra 245, A. nigriventris 245, Platyura 246, P. parva 250, P. fasciola 251, P. inops 252, P. setiger 252, P. lurida 253, P. pictipennis 253, P. elegans 254, P. mimula 255, P. melasoma 255, P. pullata, 256, P. nigrita 256, P. notabilis, 257, P. ignobilis 257, P. fascipennis 257, P. fasciventris 258, P. moesta 259, P. mendosa 259, P. mendica 260, P. subterminalis 261, P. diluta 261, P. moerens 262, P. genualis 262, P. scapularis 263, P. elegantula 264, P. taeniata 264, P. divaricata, Macrocerinae 265, Macrocera 265, nebulosa 269, M. hirsuta 269, M. formosa 270, M. clara 271, M. concinna 272, M. germinata 272.

Ent. 39. Me. Agric. Exp. Sta. Bul. No. 173. CHERMES OF MAINE CONIFERS. By Edith M. Patch.

Contains a discussion of the following species:

1. *Chermes pinifoliae* Fitch. Figs 108, 109. Drawings of migrant Figs. 127-132. Photos of galls of *pinifoliae* on spruce, migrants ovipositing on white pine needles, etc. Description, life history notes and historical discussion of this species which develops in a cone-like gall on the black and red spruces (in which connection it was named *abicticolens* in 1879 by Thomas and subsequently merged by error with *abictis* in 1897), and migrates to the needles of the white pine(in which connection it had been previously named pinifoliae by Fitch in 1858, and merged by error with *pinicorticis* in 1869). pp. 277-289.
2. *Chermes abietis*. Figs. 115, 117. Drawings of winged form and pupa Figs. 137-140, photographs of galls on on spruce, description and life history notes of this species which lives exclusively upon the spruce. pp. 290-294.
3. *Chermes similis* Gillette. Figs. 114, 116. Drawings of insect. Figs. 142-144. Photos of galls and work on spruce. Description and life history notes of this spruce species. pp. 301-303.
4. *Chermes lariciatus* Patch. Figs. 118, 122, drawings of migrant and pupa. Fig. 141 photo of gall on white spruce. Description and life history notes of this spruce-larch species. pp. 294-297.
5. *Chermes consolidatus* Patch. Figs. 123-126. Drawings of insect. Fig. 145 photo of gall on black spruce. Description and life history notes of this spruce-larch species. pp. 297-299.
6. *Chermes floccus* Patch. Figs. 110-112. Drawings of insect. Figs. 133-136 photos of gall on spruce and migrants on needles of white pine. Description and life history notes of this spruce white-pine species. pp. 299-301.

7. *Chermes pinicorticis* Fitch. Fig. 146. Photo of this flocculent species on white pine. Brief discussion of this species with reference to the literature. pp. 303-304.

Ent. 40. Chermes of Maine Spruces. By Edith M. Patch. Psyche Dec. 1909, pp. 136-137. Brief descriptions and notes on the following species:—

Chermes pinifoliae Fitch.
Chermes abietis Linn.
Chermes similis Gillette.
Chermes floccus n. sp.
Chermes consolidatus n. sp.
Chermes lariciatus n. sp.

List of Insect Circulars for General Replies to Inquiries in Regard to Certain Insects of Maine.

Circ. 206-12-04. The Brown-tail Moth.
" 212- 2-05. The Cottony Grass-scale.
" 223- 5-05. Concerning Insects for Identification.
" 240- 7-06. White Grubs and June Beetles. Published also in Bul. 137.
" 247- 7-06. Red-humped Caterpillar, *Oedemasia concinna*. Published also in Bul. 137.
" 249- 8-06. Yellow-edge or Mourning Cloak Butterfly. Published also in Bul. 137.
" 250- 8-06. Elm-leaf curl. Published also in Bul. 137.
" 251- 8-06. Yellow-necked Caterpillar, *Datana ministra*. Published also in Bul. 137.
" 253- 9-06. The Cecropia Moth. Published also in Bul. 137.
" 254- 8-06. Tent Caterpillar. Published also in Bul. 137.
" 255-10-06. Tussock Moth. Published also in Bul. 137.
" 257-11-06. Brown-tail Moth.
" 262-12-06. The Gypsy Moth.
" 275- 4-07. The Apple Maggot or Railroad Worm.
" 288-11-07. The Polyphemus Moth.
" 291-11-07. Plum Curculio.
" 292-11-07. The Turnus or Tiger Swallow-tail Butterfly.
" 293-11-07. Sphinx Chersis and Other Hawk Moths.
" 294-11-07. Fall Web Worm.
" 295-11-07. The Luna Moth.
" 296-11-07. Hickory Tiger Moth.
Spotted Tiger Moth.
" 297-11-07. The Bud Moth.
" 299-11-07. Cherry Tree Ugly Nest.
" 300-11-07. Io Moth.
" 318- 5-08. Forest Tent Caterpillar.

See page 136.

EXPERIMENTS IN IMPROVEMENT OF PLANTS BY SEED SELECTION.

The idea prevails to a considerable extent that great improvement may be made in the productiveness of agricultural plants by the careful selection of the largest, plumpest seeds for planting. With a view of learning to what extent if any, such improvements could be brought about the following experiment was undertaken. Four varieties of oats were taken from which were selected the largest, heaviest kernels to the amount of two quarts in each case. These were sown on plots of land 12 feet by 90 feet while like amounts of the same varieties of oats which were taken from the common stock were sown on similar adjoining plots. Both sets of plots received the same treatment as to cultivation and manure.

In the following table the results are given:

Oats—Variety.	Yield of grain when largest and heaviest kernels selected for seed.		Yield of grain from seed from the common stock.		Weight of measured bushel from selected seed.	Weight for measured bushel from common seed.
	lbs.	oz.	lbs.	oz.	lbs.	lbs.
Clydesdale	38	0	19	0*	34	34
New Race Horse	42	8	43	0	36	36.5
White Victoria	42	4	30	12	35	37
White Seizure	44	12	43	12	32	36

*The Clydesdale plot sown to the common seed was invested with witch grass and the yield much depressed.

During the growing season many who visited the plots believed those which were planted with the selected seed, to have stronger and more vigorous plants. An examination of the results show no increase in the weight of a measured bushel of the oats from the selected seed over those grown from the common stock, and it is very doubtful if any actual gain has been made in the yield per plot.

REPORT OF BOTANIST AND ENTOMOLOGIST.*

Prof. F. L. Harvey.

GERMINATION EXPERIMENTS.

It is well known that seeds often fail to germinate, causing great loss to the planter. To what extent poor seed is offered for sale in this state is not known. Farmers do not usually take the trouble to sprout seed before planting. The germinating power of seed cannot readily be told by its appearance, and there is opportunity for dishonest dealers to mix old seed with fresh, and sell an inferior quality, without danger of being detected. Reliable dealers may sell a poor quality of seed without knowing it. If the quality of seed offered for sale in our markets could be improved, it would be a great saving to farmers. Published accounts of the germinating power of seeds offered for sale by seedsmen will make them more careful of the quality of seed sold, and also help protect reliable dealers from disreputable ones.

Failure to germinate may be due to imperfections in the seed, or result from improper management of it by the planter.

Seed, to be reliable, should be mature and plump when gathered; properly dried and kept from changing conditions of heat, cold and moisture until planted; should not be too old; true to name; entirely free from insect depredations and the seeds of noxious weeds. When possible, select seed from the same or from a more northern latitude. Lightness in weight indicates immaturity or weakness. Low germinating power may be due to immaturity or weakness, improper care of seed after it is gathered, or to great age. Insect depredations and the presence of foreign seeds can usually be detected by a pocket lens. To determine whether a seed is true to name it has to be grown, or, more quickly, it may be compared with a correctly named sample.

To properly germinate, seeds require heat, moisture and free access of air. The relative amount differs with different seeds.

Proper time, depth and method of planting; and the conditions of soil as regards heat, moisture and porosity, are almost as important to the planter as good seed.

Seeds with a small chit or embryo start slowly and suffer more from vicissitudes than those with a large, strong embryo. In gen-

* Papers from the Maine Agricultural Experiment Station: Entomology No. 1.

eral, small seeds demand shallow planting and larger ones more depth of soil. Nothing is gained by planting before the soil is warm enough or properly drained, but the seed is frequently lost. Seeds buried in a cold, moist soil any length of time are liable to rot. The soil should be dry enough to work, porous, allowing access of air to the seed. Seeds planted early should be more lightly covered, so as to secure necessary warmth.

So complex and variable are the conditions due to the season, soil and seed, that no invariable rules for planting can be formulated. The planter has largely to rely upon his experience and judgment, even when his seed is first class.

To remove or lessen one cause of failure would require more careful farming. The other cause of failure can be lessened by a careful, systematic inspection of seeds. To determine to what extent the failure of seeds to germinate is due to inferior quality, the station will conduct germination tests from year to year; and, as was indicated in bulletin No. 24, May, 1888, inspect seeds sent by the farmers of the state as to their purity and germinating power.

For the germination tests conducted this season, there were selected for examination and comparison, seeds offered for sale by wholesale dealers in the state; those kept at stores to be sold on commission; those obtained direct from wholesale houses outside the state, and those distributed by the Department of Agriculture.

The material for this season's work was obtained from the following sources: Edwin Chick & Co., Bangor, Me., direct; R B. Dunning & Co., Bangor, Me., direct; Kendall & Whitney, Portland, Me., direct; B. Walker McKeen, Fryeburg, Me., direct; E. W. Burbank, Fryeburg, Me., direct; Thos. W. Emerson & Co., Boston, Mass., Dunning, Bangor; D. M. Ferry & Co., Detroit, Mich., direct; David Landreth & Sons, Philadelphia, Pa., direct; James M. Thorburg & Co , New York, N. Y., direct; Iowa Seed Co., Des Moines, Iowa, Department of Agriculture; Department of Agriculture, Washington D. C., direct.

GERMINATORS.

The germinator used was a galvanized tray eight inches deep, covered with a dome shaped lid. On the inside of the tray, on two sides, and one inch from the top, were soldered waving shelves, in

the groves of which rods to support pockets or folds of canton flannel cloth were placed.

Near the top of the tray, above the shelves, was a row of one half inch holes for admitting fresh air. Water to the depth of two inches was placed in the tray. The pockets were provided with two free ends of cloth which extended below into the water, carrying moisture to the seed by capillary attraction. The pockets were three inch deep and two inches from the water. The greater depth of water in the tray, than is commonly used, secured a more uniform temperature. Very small seeds were germinated in porous flower pot saucers, set in water in the bottom of the tray, deep enough to keep them moist. To sterilize the trays and pockets they were scalded after each experiment. *The above apparatus was satisfactory.*

In all the tests *one hundred* seeds were used. They were counted and weighed, and then put into the pockets without being soaked and spread so as not to touch each other. They were examined daily and those sprouted were removed, counted and recorded. The experiments were continued two weeks, if any sound seeds remained that length of time unsprouted, and then the sound seeds left were counted.

The following tables are a record of the results of experiments conducted the past season. Seeds of the same kind are grouped together for the purposes of comparison.

It is well known that with the uniform conditions maintained in germination tests that usually a larger per cent of seeds will sprout, than would vegetate under the variable conditions of out door planting. Yet it does not follow that the testing of seeds is useless

Seed showing a high germination per cent would almost invariably be reliable for planting, while those that do not start with favorable conditions would be worthless.

RESULTS OF GERMINATION TESTS—GARDEN SEEDS.

Serial number.	Station number.	Description.	Weight of 100 seeds in grams.	Per cent. of impurities by weight.	Number of seeds sprouted each day.													Sound seeds left.	Per cent. sprouted.	No. of days required for one-half to sprout.
					1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th			
		LETTUCE.																		
1	1	Early White Cabbage, Chick	.141	1	–	–	99	–	–	–	–	–	–	–	–	–	–	–	1	99	3
2	14	Boston Curled, Dunning	.087	1	–	–	61	–	10	2	–	1	–	–	–	–	–	–	22	77	3
3	38	" " Emerson	.096	–	–	–	–	10	–	–	–	–	–	–	–	–	–	–	90	10	3
4	47	Ferry's Early Prize, Ferry	.137	–	–	–	95	–	–	1	–	1	–	1	–	–	–	–	–	98	3
5	163	White Chavigne, Dep't Agriculture	.120	–	–	33	34	11	5	–	–	–	–	–	–	–	–	–	–	86	3
6	164	White Paragon, " "	.146	–	68	25	–	1		–	–	–	–	–	–	–	–	–	–	94	1
		TURNIP.																		
7	2	Skirving's Ruta Baga, Chick	.242	–	–	–	51	5	7	3	5	4	–	1	–	–	–	–	9	76	3
8	17	Ruta Baga, Dunning	.329	–	–	–	–	5	6	3	5	2	3	1	1	1	–	–	45	29	
9	37	" " Emerson	.256	–	–	–	94	0	3	–	–	–	–	–	–	–	–	–	3	97	3
10	46	" " Ferry	.275	–	–	–	56	4	3	4	2	–	–	–	–	–	1	1	22	71	3
		CABBAGE																		
11	3	Fottler's Improved Brunswick, Chick	.331	–	–	–	60	–	8	2	3	1	–	–	–	–	–	–	6	69	3
12	16	Drumhead, Dunning	.326	–	–	–	75	5	3	–	2	1	–	–	–	–	–	2	6	88	3
13	36	Fottler's Improved Brunswick, Emerson	.334	–	–	–	83	–	4	–	–	3	1	–	–	–	–	1	3	92	3
14	42	Large Drumhead, Ferry	.346	–	–	–	66	3	2	1	–	–	–	–	–	–	1	–	2	73	3
15	155	Extra Early Pointed Market, Dep't Agr.	.387	–	–	42	29	2	3	1	–	–	1	–	–	–	1	–	20	79	3
16	156	Buncome, Dep't Agr	.325	–	20	54	8	3	–	–	–	–	–	–	–	–	1	–	3	86	2
17	157	Berkshire Beauty, Dep't Agr	.435	–	–	56	26	7	3	2	–	–	1	–	–	–	–	–	1	95	2
18	158	Stone Mason, Dep't Agr	.320	–	–	16	9	2	16	7	4	1	2	–	–	–	–	1	38	61	6

RESULTS OF GERMINATION TESTS—GARDEN SEEDS.—(Continued).

Serial number.	Station number.	Description.	Weight of 100 seeds in grams.	Per cent. of impurities by weight.	Number of seeds sprouted each day.													Sound seeds left.	Per cent. sprouted.	No. of days required for one-half to sprout.
					1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th			
		Parsnip.																			
19	4	Long Smooth, Chick	.438	1	–	–		10	–	23	3	–	5	–	3	–	–	–	50	44	
20	18	Long Dutch, Dunning	.421	–	–	–	–	–	1	3	5	3	4	7	4	3	4	–	58	34	
21	39	Hollow Crown, Emerson	.376	–	–	–	–	–	7	10	7	6	8	4	4	–	1	2	41	49	
22	43	Long White Dutch, Ferry	.400	–	–	–	–	–	7	10	14	26	5	3	3	2	–	–	26	70	8
		Celery.																			
23	5	Boston Market, Chick	.035	–	–	–	–	–	–	–	3	3	–	4	4	5	6	2	70	27	
24	19	" " Dunning	.047	–	–	–	–	–	–	3	4	6	–	21	7	10	8	3	36	62	12
25	44	" " Ferry	.042	–	–	–	–	–	–	4	6	10	13	7	5	–	2	1	47	48	
		Onion.																			
26	6	Yellow Danvers, Chick	.390	–	–	48	19	3	2	1	1	–	–	–	–	–	–	–	20	74	
27	12	" " Dunning	.370	–	–	20	27	9	3	1		2	–	–	–	–	–	–	25	62	4
28	35	" " Emerson	.344	–	–	33	37	17	3	3	2	–	–	–	–	–	–	–	5	95	3
29	43	" " Ferry	.412		–	17	30	8	4	3	1	3	1	–	–	–	–	–	25	67	4
		Beet.																			
30	7	Dewing's Early Turnip, Chick	1.937	–	–	3	32	14	2	2	2	3	2	–	1	1	1	–	35	63	5
31	13	" " " Dunning	1.633	–	–	–	–	1	3	2	4	1	3	2	1	1	–	–	82	18	
32	34	" " " Emerson	2.230	–	–	7	38	18	5	4	2	2	1	–	–	–	–	–	20	77	4
33	40	Early Blood " Ferry	2.022	–	–	1	41	24	3	3	2	2	–	–	–	–	–	–	22	76	4

34	149	New Market Gardner's, Iowa Seed Co.	2.468	-	-	1	12	22	18	-	-	-	-	-	-	2	-	-	40	60	5
35	150	Osborn's Selected, Dep't Agr.	1.560	-	-	3	52	16	12	2	-	1	-	-	-	-	1	-	13	87	3
36	151	Eclipse, Dep't Agr	1.282	-	-	2	11	22	9	5	2	3	1	2	1	1	-	-	41	59	7
37	145	Lane's Imperial Sugar, Dep't Agr.	2.226	-	-	-	-	14	18	5	4	1	2	-	1	-	1	-	54	46	
38	146	Improved Imperial Sugar, Dep't Agr.	2.618	-	-	-	26	19	12	4	5	-	-	1	1	1	1	-	30	70	5
39	147	Vilmorin's Sugar, Dep't Agr	2.430	-	-	-	45	34	14	-	-	-	-	1	-	-	-	-	6	94	
40	148	Excelsior " " "	2.093	-	-	-	2	14	15	6	3	1	-	-	-	-	-	-	59	41	4
		CARROT.																			
41	15	Long Orange, Dunning	.125	2	-	-	4	7	17	19	1	2	-	1	-	-	-	-	23	51	8
42	33	Prize Long Orange, Emerson	.150	-	-	-	3	28	14	2	1	-	-	-	-	-	-	-	50	48	
43	41	Improved Long Orange, Ferry	.110	-	-	-	14	16	13	6	1	5	1	2	1	1	-	-	25	60	7
		TOMATO.																			
44	159	Reed's Island Beauty. Dep't Agr.	.310	-	-	2	52	27	9	1	-	-		1	-	-	-	1	1	93	3
45	160	Beauty, Dept Agr.	.320	-	2	26	50	9	2	-	-	2	-	-	-	-	-	-	4	91	3
46	161	Early Advance, Dep't Agr	.278	-	-	1		3	6	3	4	1	1	-	1	-	-	-	80	20	
47	162	Boston Market, Dep't Agr.	.286	-	-	-	2	5	7	3	5	-	3	1	2	-	-	-	72	28	
		SWEET CORN.																			
48	48	Common B. W. McKeen	18.920	-	-	-	10	42	20	17	1	-	-	-	-	-	-	-	-	90	4
49	152	Perry's Hybird, Dep't Agr.	24.200	-	-	-	4	25	28	23	2	1	-	-	-	-	-	-	-	83	5
50	153	Breck's Perrennial Dep't Agr.	23.578	-	-	-	11	27	25	10	2	6	1	-	-	-	-	-	-	82	5
51	154	Burbank's Improved, E. W. Burbank	28.084	-	-	-	0	11	30	42	12	3	-	-	-	-	1	-	-	99	6
		LEGUMES—CLOVER.																			
52	8	Common Red, *Trifolium pratense*, Chick.	.164	-	-	-	92	-	-	-	-	-		-	-	1	-	-	7	93	3
53	25	Pea Vine, " Dunning.	.154	-	-	-	97	-	-	-	-	-	-	-	-	-	-	-	2	97	3
54	27	Primo Medum, " "	.166	-	-	-	96	-	-	-	-	-	-	-	-	-	-	-	3	96	3
55	88	Common Red, " Thorburn	.148	-	70	13	3	-	-	-	-	-	1	-	-	-	-	-	11	87	1
56	91	Pea Vine, " "	.160	-	48	39	3	1	-	-	-	-	-	-	-	-	-	-	5	91	2
57	113	" " Kend. & Whit.	.16	-	53	36	4	1		-	-	-	-	-	-	-	-	-	-	94	1
58	114	North New York, " "	.160	-	64	27	1	-	-	-	-	-	-	-	-	-	-	-	3	92	1
59	115	Michigan, " "	.157	-	27	52	2	-	-	-	-	-	-	-	-	-	-	-	-	81	2
60	11	Alsike, *Trifolium pratense, hybridum*, Chick.	.060	-	2	39	26	12	2	2	-	-	2	-	2	-	1	-	4	88	3
61	24	" " " Dunning	.068	-	1	11	10	8	10	14	6	5	3	1	3	-	-	-	8	72	6
62	86	" " " Thorburn	.066	-	57	11	-	-	1	-	-	-	-	-	-	-	-	-	31	69	1
63	116	" " " Kend. & Whit	.068	-	22	30	4	5	5	1	-	-	-	-	1	-	1	-	23	69	2
64	125	" " " Landreth	.070	-	36	26	6	7	2	1	-	-	-	-	-	-	-	-	15	78	2

RESULTS OF GERMINATION TESTS—GARDEN SEEDS.—(CONTINUED).

Serial number.	Station number.	Description.	Weight of 100 seeds in grains.	Per cent. of impurities by weight.	No. of seeds sprouted each day.													Sound seeds left.	Per cent. sprouted.	No. of days required for one-half to sprout.
					1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th			
		LEGUMES—CLOVER.																			
65	10	White, *Trifolium pratense, repens,* Chick..	.057	-	-	3	15	26	7	15	7	2	3	-	-	-	-	-	18	78	4
66	26	" " " Dunning...	.054	-	-	-	85	-	1	-	1	-	-	-	-	-	-		8	87	3
67	92	" " " Thorburn..	.060	-	55	27	3	-	-	-	-	-	-	-	-	-	-	-	13	85	1
68	117	" " " K. & W...	.065	-	27	48	4	2	1	1	-	-	-	-	-	-	-	-	13	83	2
69	97	Incarnate, " *incarnatum,* Thorburn ..	.368	-	95	5	-	-	-	-	-	-	-	-	-	-	-	-	-	100	1
		LEGUMES.																			
70	95	Yellow Trefoil, Thorburn ..	.175	-	41	40	3	-	1	-	-	-	-	-	-	-	-	-	-	85	2
71	124	" " Landreth .	.173	-	12	59	7	5	-	-	-	-	-	-	-	-	-	-	-	83	2
72	94	Alfalfa or Lucerne, *Medicago sativa,* Thorburn	.220	-	21	34	6	1		-	-	-	1	-	-	1	1	-	36	65	2
73	118	" " Landreth	.226	-	40	49	2	1	-	-	-	1	-	-	-	-		-	3	93	2
74	87	Bakhara or S Clover, *Melilotus alba,* Thorburn	. 56	-	33	6	2	27	-	-	-	-	-	-	-	1	-	-	25	69	4
75	89	Bush Clover, *Lespedeza striata,* Thorburn.....	.103	-	-	3	8	35	20	5	-	1	-	-	1	-	-	-	20	73	5
76	85	Furze, *Ulex Europæus,* Thorburn	.668	-	92	1	-	0	-	-	-	-	-	-	-	-	-	-	2	93	1
77	90	Cow Peas, *Dolichos sinensis,* Thorburn	19.890	-	-	12	30	45	9	4	-	-	-	-	-	-	-	-	-	100	4
78	93	Sainfoin, *Onobrychis sativa,* Thorburn	1.963	-	-	0	7	15	4	11	12	8	7	3	2	1	-	-	6	70	7
79	119	" " Landreth.....	2.061	-	-	0	2	10	14	7	14	6	3	5	-	2	1	-	19	64	8
		MISCELLANEOUS																			
80	82	*Madia sativa,* Thorburn.	.732	-	1	88	7	-	-	-	-	-	-	-	-	-	-	-	-	97	1
81	96	Spurrey, *Spergula arvensis,* Thorburn	.091	-	-	26	9	8	5	1	2	2	1	-	2	-	1	-	24	57	7

		GRASSES—MILLET.																							
82	22	Golden, *Panicum miliaceum*, Dunning.....	.010	-	-	-	85	-	1	-	-	-	-	-	-	-	-	-	2	87					
83	110	" " Kend. & Whit...	.232	-	4	54	30	3	-	-	-	-	-	-	-	-	-	-	8	91	3				
84	122	Southern, Landreth	.190	-	4	86	2	-	-	-	-	-	-	-	-	-	-	-	-	92	2				
85	81	Pearl, Thorburn...	.560	-	10	50	3	-	2	-	-	-	-	-	-	-	-	-	14	65	2				
86	21	Hungarian, *Panicum Germanicum*, Dunning	.223	-	-	-	78	-	2	1	1	-	1	-	-	-	-	-	5	82	2				
87	84	" " Thorburn,	.184	-	-	20	6	-	-	1	-	-	-	-	-	-	-	-	50	27	3				
88	112	" " K. & W.	.181	-	3	55	6	4	-	-	-	1	1	-	-	-	-	-	22	68	2				
89	126	" " Landreth,	.212	-	-	64	2	2	-	-	-	-	-	-	-	-	-	-	13	68	2				
		GRASSES.																							
90	9	Timothy, *Phleum pratense*, Chick..	.040	-	-	-	30	50	2	-	-	-	-	-	-	-	-	-	10	88	4				
91	20	" " Dunning.	.040	-	-	-	8	24	9	-	-	-	-	1	-	1	-	-	5	95	5				
92	66	" " Thorburn	.040	-			25	51	3	-	-	-	-	-	-	-	-	-	10	91	4				
93	111	" " Kend. & Whit ...	.034	-	-	-	0	7	-	-		-	-	-	-	-	-	-	2	96	6				
94	23	Fancy Red Top, Dunning.	.010		-	-	10		1	3		3	-	1	-	-	-	-	20	80	4				
95	109	Fancy Red Top, Kend. & Whit....	.009	-	-	-	2	10	14	7	14	6	3	5	-	2	1	-	19	64	8				
96	32	Red Top, *Agrostis vulga is*, Dunning.	.008	84	-	-	1	7	6	4	-	1	1	-	-	-	-	-	80	20					
97	57	" " " Thorburn	.010	-	-	-	-	2	12	5	4	1	-	-	-	-	-	-	75	25					
98	31	Rhode Island Bent, *Agrostis canina*, Dunning.	.009	-	-	-	23	37	7	10	2	1	-	1	-	-	-	-	19	81	4				
99	49	" " " " Thorburn	.006	77	-		-	4	12	18	7	8	1	-	1	1	-	-	48	52	9				
100	102	" " " " K. & W	.009	3	-	-	-	-	4	10	16	9	4	-	2	2	-	-	50	47					
101	52	Creeping Bent, *Agrostis stolenifera*, Thorburn	.006	-	-	-	-	4	12	18	7	8	1	-	1	1	-	-	48	52	9				
102	30	Fowl Meadow, *Poa serotina*, Dunning.....	.010	70	-	-	-		4	5	1		2	-	-	-	-	-	88	12					
103	77	" " " Thorburn.	.010	50	-	-	-		-	1	-		1	1	-	-	-	-	97	3					
104	104	" " " Kend. & Whit ..	.014	90	-	-	-	-		2	9	11	2	2	9	12	2	1	50	50	14				
105	129	" " " Ferry	-	90	-	-	-			1	2	1	1	2	9	13	2	1	68	32					
106	28	Kentucky Blue, *Poa pratensis*, Dunning.....	.018	-	-	-	-				1	-	-	3	1	-	-	-	95	5					
107	68	" " " Thorburn	.023	-	-	-	-	-	-	-	-	1	-	5	1	2	2	1	88	12					
108	100	" " " Kend & Whit.	.021	1	-	-	-	-		-	1	2	5	1	4	2	2	-	83	17					
109	70	Wood Meadow, *Poa nemoralis*, Thorburn .	.020	-	-	-	-	1	-	1	2	3	4	1	2	1	0	-	85	15					
110	128	" " " Ferry.	.018	-	-	-	-	-	-		1	1	2	1	3	3	2	1	86	14					
111	63	Water Meadow, *Poa aquatica*, Thorburn	.024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100						
112	71	Rough Stalked Meadow, *Poa trivialis*, "	.019	10	-	-	-	3	1	1	1	-		1	4	1	1		87	13					
113	75	Canada Blue, *Poa compressa*, "	.020	-	-	-	-	-	-	1	-	4	1	4	-	-	1	-	89	11					
114	29	Orchard, *Dactylis glomerata*, Dunning	.059	-	-	-	-	-	7	-	9	5	2	6	4		3	2	60	38					
115	69	" " " Thorburn.. ...	.066	-	-	-	-	2	24	10	5	5	6		2	-	1	2	40	57	9				
116	98	" " " Kend. & Whit.	.075	-	-	-	-	-	15	3	13	5	8	2	-	-	2	2	50	50	14				
117	61	Tall Meadow Oat, *Avena elatior*, Thorburn	.292	-	-	-	2	6	33	4	1	1	-	-	1	-	-	-	50	48					
118	99	" " " " Kend. & Whit	.175	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	98	2					

RESULTS OF GERMINATION TESTS—GARDEN SEEDS.—(Concluded).

Serial number.	Station number.	Description.	Weight of 100 seeds in grains.	Per cent. of impurities by weight.	Number of seeds sprouted each day.													Sound seeds left.	Per cent. sprouted.	No. of days required for one-half to sprout.
					1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th			
		GRASSES.																			
119	127	Tall Meadow Oat, *Avena elatior*, Ferry	.222	-	-	-	9	35	8	6	-	-	-	-	1	-	1	-	40	60	5
120	64	S. Vernal, *Anthoxanthum adoratum*, Thorburn	.054	-	-	-	-	-	5	4	-	1	1	1	-	1	1	-	80	14	
121	103	" " " K. & W.	.058	-	-	-	-	2	4	6	2	-	1	-	1	2	1	-	80	19	
122	123	" " " Landreth	.044	-	-	-	-	3	6	2	2	1	-	-	1	-	-	-	85	15	
123	54	Meadow Fescue, *Festuca pratensis*, Thorburn	.141	-	-	-	-	-	3	4	-	3	-	-	1	1	-	1	87	13	
124	105	" " " K. & W.	.082	-	-	-	-	-	1	2	1	-	-	-	-	2	-	-	90	6	
125	130	" " " Ferry	.151	1	-	-	-	16	34	12	3	3	3	2	-	-	-	-	20	73	5
126	57	Tall Fescue, *Festuca elatior*, Thorburn	.099	-	-	-	-	2	12	5	4	1	-	-	1	-	-	-	75	25	
127	107	" " Kend. & Whit.	.174	-	-	-	-	2	7	4	4	-	2	-	-	-	4	2	75	25	
128	55	Various-leaved Fescue, *Festuca heterophylla*, Thorburn	.095	-	-	-		-	-	-	-	-	1	-	-	-	-	2	97	3	
129	56	Sheep's Fescue, *Festuca ovina*, "	.045	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	97	3	
130	58	Slender Fescue, *Festuca tenuifolia*, "	.022	-	-	-	-	-	9	8	3	2	1	1	1	2	1	2	70	30	
131	74	Hard Fescue, *Festuca duriuscula*, "	.055	-	-	-	-	-	1	1	-	-	-	-	1	-	-	-	90	3	
132	60	Italian Rye, *Solium Italicum*, Thorburn	.225	-	-	-	52	14	3	22	4	-	-	-	1	-	-	-	2	96	3
133	120	" " Landreth	.144	-	-	-	5	10	8	4	3	2	-	3	-	-	-	-	65	35	
134	73	Perrennial Rye, *Solium perenne*, Thorburn	.170	-	-	-	-	12	20	3	3	1	4	-	2	-	-	-	55	45	
135	106	" " Kend & Whit	.165	-	-	-	-	17	9	7	-	1	1	1	-	-	-	-	57	36	
136	121	" " Landreth	.202	-	-	-	30	32	11	3	6	-	-	-	1	-	-	-	10	83	4
137	72	Johnson, *Sorghum halapense*, Thorburn	.408	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	98	2	6
138	131	" " Ferry	.242	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-
139	108	Lawn, (mixture) Kend. & Whit	.022	2	-	-	-	2	20	53	8	1	-	-	-	-	-	-	15	84	6

140	50	Slender Foxtail, *Alopecurus agrestis*, Thorburn	.212	2	-	-	-	-	27	11	8	4	2	1	-	-	-	-	-	-	-	43	53	7
141	53	Wood Hair, *Aira flexuosa*, "	.041	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	99	1	
142	62	Rescue, *Bromus Schraderi*, "	1.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	
143	65	Meadow Brome, *Bromus pratensis*,	.461	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	
144	79	Soft Chess, " *mollis*	.284	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	57	2	
145	59	Beach, *Ammophila arenaria*, Thorburn	.396	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-	97	3	
146	67	Meadow Soft, *Halcus lanatus*, Thorburn	.054	5	-	-	-	1	1	12	-	4	1	-	3	-	-	-	-	-	-	74	22	
147	76	Reed Canary, *Phalaris arundinacea*, Thorburn	.062	-	-	-	-	-	4	1	1	-	-	-	-	-	-	-	-	-	-	94	6	
148	78	Crested Dogstail, *Cynosurus cristatus*, "	.034	-	-	-	-	-	-	-	-	4	2	1	2	2	-	-	-	-	-	89	11	
149	80	Teosinte, *Reana luxurians*, Thorburn	6.822	-	-	-	3	2	1	2	-	-	-	-	-	-	-	-	-	-	-	92	8	
150	83	Kaffir Corn	2.488	-	-	93	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98	2

COMPARATIVE RESULTS OF GARDEN SEEDS GERMINATED.

Name.	Chick's seed in bulk.		Dunning's seed in bulk.		Emerson's commission seeds in packets.		Ferry's seeds in packets		Iowa Seed Company's seeds in packets.		Dept Ag—seeds in packets.	
	Varieties tested.	Average per cent germinated.	Varieties tested.	Average per cent germinated.	Varieties tested.	Average per cent germinated	Varieties tested.	Average per cent germinated.	Varieties tested.	Average per cent germinated.	Varieties tested.	Average per cent germinated.
Lettuce.....	1	99	1	77	1	10	1	98	–	–	2	90
Turnip.....	1	76	1	29	1	97	1	71				
Cabbage	1	69	1	88	1	92	1	73	–	–	4	80
Parsnip.....	1	44	1	34	1	49	1	70				
Celery	1	27	1	62	1	48						
Onion.....	1	74	1	62	1	95	1	67				
Beet.....	1	63	1	18	1	77	1	76	1	60		
Carrot.....	–	–	1	51	1	48	1	60			6	66
Tomato....	–	–	–	–	–	–	–		–		4	58

The complaint about commission garden seeds is hardly sustained by our experiments. Emerson's seeds, the only ones tested, make a fair average showing. The lettuce seed was very poor, only ten per cent sprouted. The turnip seed was the best examined and the cabbage and beet seed were excelled only by varieties from the department of agriculture. The onion seeds were superior. The carrot seed was the poorest examined and the tardy germination showed it was old. The freshness of the garden seeds from the department of agriculture is shown by their early germination and good germination per cent.

The garden seeds, Nos. 1 to 51, vary considerably. Farmers and gardners find it difficult to get these kind of seeds to "come up" well. Although at times it may be due to unfavorable conditions of the soil or weather, it is more often due to the seed. If poor seeds are planted, poor results are certain. Beet seed is one of the hardest to sprout. By comparing the beet seed of different dealers, we find the range from 18, to 94, more than five times as many in one case, as in the other, and of greater vitality, as is shown by the number

of days of germination. The lowest, No. 31, was given two trials in the germinator, and one in wet sand, 18 per cent being the most sprouted. We found in this case, as well as in others, that the largest seeds gave the best results. Notice the weight of seeds given in the table, and it will generally be found that the heaviest are the best. On the whole the garden seeds show a fair rate of vitality, the exceptions can be easily seen.

By looking in the column marked "Per Cent Sprouted," it will be seen that the range is as wide as is possible, being 100 in the cow-peas, and incarnate or scarlet clover, and 0 in four of the grasses. As the conditions were very nearly the same in each case, it plainly shows the difference in seed. By comparing the grasses one will see that in the more common kinds, for instance Timothy, the per cent germinated is high, 88 to 95, while in those rarely sown it is low. This is easily explained, as seed for which there is but a slight demand, would remain on sale for a long time, so that the greater the demand the newer the seed. This is a good illustration of the differenee between new and old seed, as the per cent sprouted varies from 95 to 0, and from the more common to the less common kinds. The clovers show a high per cent of germination, throughout, some of them sprouting 95 per cent, in twenty-four hours from the time they were put in the germinator. In studying the tables notice the number of days before the seeds began to sprout, as rapid sprouting shows high vitality.

The conclusions we draw from these experiments put into rules to aid in purchasing seed, would be, see that seeds look new and fresh, notice whether they are plump or shriveled, and whether or not they are uniform in size. If some are large and some small, only the former will grow. Also see that they are free from foul seeds, as many troublesome weeds are introduced in this way. Buy of some reliable dealer, and continue to do so as long as the seeds are satisfactory. Buy seeds grown in our own State or from localities as far north. Farmers can easily test seeds, by putting them between damp cloths, or sheets of blotting paper.

Experiments with Forage Plants.

Sixty-six plots were sown last spring with grass seed and the seeds of other forage plants. A report will be made of these experiments another season. The station has started a collection of seeds, and steps are also being taken to form a herbarium of grasses and other forage plants.

POTATO SCAB.

This important disease of the potato has been studied somewhat the past season to determine if possible whether it is due to a fungoid parasite. Quite extended microscopical examination failed to show any evidence of mycelium or spores in the tissues about the scabs, that would account for the effect. The withered tissue in the scabs in some cases was mouldy but this was secondary not primary. The only organic form observed excepting mould was animal, viz: *Nematoid worms*, not unlike the vinegar eel. These were not always present and when found were probably there to feed upon the fermenting starch. The disease is certainly local in the scabs, the adjoining tissue being perfectly normal and not even discolored. The disease is confined to the cortical and sub-cortical cells and has all the appearance of having resulted from mechanical injury, which has ruptured the skin, the wound being healed by the shriveling of the adjacent tissue or the formation of a layer of cork cells under the scabs. Though variable in size the scabs are so characteristic they must be due to a common cause. Extensive experiments conducted at the Massachusetts Experiment Station seem to show that the disease is not propagated by the seed, scabby seed producing healthy tubers and vice versa.

Those who have made this disease a careful study believe it is not due to animal or plant parasites, but is caused by the conditions of growth. Experiments conducted at the N. Y. Experiment Station to test the effects of soil, excessive moisture, chemical fertilizers and fresh stable manure upon the production of scab, seem to show that fresh manures and excessive moisture increase the disease. It appears that conditions favoring rapid growth also favor the production of scab. Much moisture in the spring followed by drought is believed to increase the disease, also a dry spring followed by a wet fall has the same effect. Uniform conditions during the season should decrease the disease, if the above is correct. It has been observed that potatoes grown in a moist atmosphere will have formed on their surface warty prominences. The skin of the potato is made of what botanists call *cork tissue*. It does not cover the tuber but at intervals there are minute structures called *lenticels* through which gases pass in and out of the potato. When the potato is exposed to excessive moisture these lenticels increase in size and the skin thickens near them, causing the warts spoken of above. If the

conditions continue this warty tissue begins to decay and a scab is formed.

The loose tissues which compose these warts would be more easily affected than other portions of the skin by corroding substances or organic compounds that happen to be in the soil. Some believe the bite of an insect or mechanical injury of any kind will produce scabs. This may be true but some more uniform and general cause is necessary to account for the disease. There is quite a general belief in this State that chip manure, excess of ashes, sawdust manure, lime or fresh manure will cause the disease but opinions are quite conflicting. It is probable that the most of these are apparent instead of real causes. The station desires to study this disease carefully and will be pleased to have potato growers who may be interested answer the following questions: kind of soil, location, drainage, old or new; crops the last two or three years; method of culture; fertilizers used and amount; kind of seed, scabby or not, time of planting and harvesting crop, product scabby or not. What conditions have you observed that seem to cause the disease.

From what has been observed it would be advisable to drain well the soil upon which potatoes are to be grown and keep it loose and porous. Avoid an excess of fertilizers that would produce in the soil corroding organic compounds. Harvest the potatoes as soon as matured.

INJURIOUS PLANTS.

Apple Scab or Black Spot—Fusicladium Dendriticum.

Attention has been called to this fungus parasite as doing considerable damage to apples in the State. Apples marketed in Orono and Bangor have been examined and the disease found to be common in this region. We also learn that it is prevalent in other portions of the State. The disease is widespread over the country destroying in some of the States annually from one-half to one-sixth of the crop.

This fungus attacks the twigs, buds, leaves and fruit, but is most noticeable on the fruit, appearing as olive green spots, with a circular outline, which become velvety as they get older. When the fungus attacks the twigs and leaves it affects the vitality of the tree. The greatest injury is done to the fruit, the marketable product. An early attack causes the fruit to shrivel and drop—a later attack produces a withered stunted growth, while a late attack upon the full

grown fruit discolors its surface and depreciates its marketable value, making it liable to rot under the scab spots when stored. The disease is worse in damp, cold seasons. It starts in the spring from germs that have lived over winter or from the plant body, which has retained its vitality in the twigs, fruit or fallen leaves. The cold, damp spring weather causes a rapid growth of spores which establish themselves upon the young fruit and leaves. The warm, dry summer weather arrests the growth which is continued again during the damp, cooler autumn months. The fungus shows some preference for certain varieties, but in bad seasons all are more or less affected. The parasite has a wonderful vitality and the plant body is probably perennial. We have now, January first, apples covered with the fungus in a vigorous growing condition. Specimens apparently dead when taken from the barrel kept moist a few days begin growth. It has been shown that the spores will germinate in about eight hours at the low temperature of 50° F., insuring an early start in the spring.

The successful treatment of this disease may be regarded as an open question but on account of the annual injury done should be carefully studied. The station wishes to conduct some experiments next season upon this disease and will be pleased to correspond with orchardists in different parts of the State where the disease was bad the past season and cooperate with them.

The life history of this fungus would suggest the application of some chemical by the spraying pump, early in the spring before the leaves start, to kill the spores as formed and prevent them attacking the young fruit and leaves.

Mr. Goff of the New York Experiment Station has tried spraying the trees early in the season with a solution of 1 pound of hyposulphate of soda to 10 gallons of water with good results.

Prof. Scribner suggests for trial the following treatment:

(1) Spray the trees early in the spring before the buds start with a solution made from 1 pound iron sulphate (copperas) and 1 gallon of water.

(2) After the fruit sets spray again with Bordeaux mixture prepared by dissolving 16 pounds copper sulphate (blue stone) in 22 gallons of water. In another vessel mix 30 pounds of lime with 6 gallons of water. After the latter cools pour the two preparations together and thoroughly mix them. It is best to prepare this mixture several days before it is needed and stir it well before applying

it. If the season is cold and damp a second application should be made later in the season. The spraying pump used to apply copper solutions should be made of copper and the valves of rubber.

To determine whether the spraying does good the application should be made only to alternate trees in the row or to one side of each tree. The effects upon the trees can thus be readily compared.

INJURIOUS INSECTS.

Quite a number of letters have been received at the station the past season asking information about insects doing injury in the State.

These letters in most cases were accompanied by specimens and were answered, when necessary, in detail giving habits, description and known remedies.

The number of letters received and the apparent want of information regarding insects doing damage to fruit and fruit trees in the State has convinced the writer that a condensed account of the characters, life history and known remedies of some of our common pests, would be acceptable to the fruit growers and farmers of the State.

In the account of insects given below we have gleaned the information from various sources and claim no originality, the object being to place in the hands of those who have not access to the writings of entomologists the means of identifying our common insects in all their stages and thus enable an intelligent warfare to be waged against them.

The cuts used to illustrate the insects considered were obtained from J. B. Lippincott & Co , of Philadelphia, and are electros after figures occurring in Saunder's Insects Injurious to Fruits.

Below is given a list of the insects that were reported and considered, together with the injuries attributed to them.

The most important of these have received attention in detail, while unimportant ones have not been illustrated and receive only passing notice.

List of Insects Reported and Examined.

	Common Name.	Scientific Name.	Depredations.
1	Round-headed Apple-tree Borer	Saperda candida, Fabr	Trunk of apple trees.
2	Flat-headed Apple-tree Borer	Chrysobothris femorata, Fabr	" "
3	Oyster-shell Bark Louse	Mytilaspis pomorum, Boucbe	Branches of apple trees.
4	Apple-tree Tent-caterpillar	Clisiocampa Americana, Harris	Foliage "
5	Forest Tent-caterpillar	" sylvatica, "	" "
6	Fall Canker worm	Anisopteryx pometaria, "	" "
7	Eye-spotted Bud-moth	Tinetocera ocellana, Schiff	" "
8	Apple-tree Aphis	Aphis mali, Fabr	" "
9	Codling Moth	Carpocapsa pomonella, Linn	Fruit of "
10	Apple Maggot	Trypeta pomonella, Walsh	" "
11	Ash-gray Pinion	Lithophane antennata, Walker	" "
12	Pear-tree Slug	Selandria cerasi, Peck	Foliage of cherry and plum trees.
13	Indian Cetonia	Euphoria Inda, Linn	Injuries not mentioned.
14	Plum Curculio	Conotrachelus nenuphar, Herbst	Fruit of the apple tree.
15	Cherry-tree Plant-louse	Myzus cerasi, Fabr	Foliage of cherry trees.
16	Imported Currant-worm	Nematus ventricosus, Klug	" currant bushes.
17	Ivy Scale Insect	Aspidiotus Nerii, Boucbe	" English ivy.
18	Black Swallow-tail Butterfly	Papilio Asterias, Cramer	Leaves of carrots and parsnips.
19	Eyed Elater	Alaus oculatus, Linn	Larva in apple-tree trunks.
20	Hawthorn Tingis	Corythuca arcuata	Foliage of butternut trees.
21	Mourning Cloak Butterfly	Vanessa antiopa, Linn	" elm trees.
22	Meal-worm Beetle	Tenebrio molitor	Larva in corn meal.

EXPLANATIONS.

By a *perfect insect* (*Imago*) is meant the form that lays the eggs. It is usually provided with wings, though the females of the bark lice and most plant lice, and the females of the fall canker-worm are wingless. The eggs hatch into the *larva*, i. e., the caterpillar, worm, grub or maggot, as the case may be. The larva changes to the *pupa* or *chrysalis*, which is the inactive or resting stage, and from the pupa the perfect insect comes forth. An insect in making a complete life history, would pass through four stages; the egg, larva, chrysalis and imago. The larva is the form that usually does the damage Unless otherwise stated the cuts shown are natural size. When the insect is shown enlarged the natural size is usually indicated by hair lines.

ROUND-HEADED APPLE-TREE BORER.

Saperda Candida, Fabr.

Complaints of injuries done by this common pest have been received from various parts of the State. One writer stated that he had taken fifteen larvæ from a single tree. The Round-headed Apple-tree Borer is a native of America and though it seems to prefer the apple, is known to affect the native crab, sugar-pear, thorn bushes, pear, quince and mountain-ash. It is widely distributed and does much damage unless carefully watched.

DESCRIPTION.

Perfect insect—A beetle about three-fourths of an inch long, with two broad white strips above running the whole length of the body—hoary white below, light brown above—legs and antenae gray. (Fig. 1, c.)

Larva—One inch long when full grown—footless. Whitish with a round chestnut colored head, polished and hornlike and armed with two black jaws. (Fig. 1, a.)

FIG. I.

Chrysalis—Lighter colored than the larva and with transverse rows of minute spines on the back. (Fig. 1, b.)

LIFE HISTORY.

The perfect insect makes its appearance in June and July, and remaining concealed during the day is not commonly seen. It becomes active at dusk and lays its eggs, one by one, on the bark, near the base of the tree. The eggs hatch in about two weeks, and the young worms begin at once to grow into the tree. The larva is three years changing to the beetle and injures the trees that length of time. The first year the larva works in the sapwood and inner bark, producing flat cavities filled with sawdust like coatings. The second summer the larva is about half grown and does great damage to the sapwood. At the close of the third season, it bores deeper into the wood making a cylindrical channel upward and then outward to the bark, filling the upper part with a powdery material. It retreats to the deepest part of the channel, fills up the passage below, turns around and waits until the following spring when it sheds its skin and becomes the chrysalis. (Fig. 1, b.) In two or three weeks the chrysalis changes to the beetle form, which opens the upper part of the channel, gnaws a hole through the bark, escapes, and in due time lays eggs, completing the life history.

REMEDIES.

The dark colored spots made in the bark where the young worms enter should be scraped until the light colored bark below is exposed and the larva found and destroyed. The best time to examine is early in September or a little later in our climate. Sometimes the bark of the dark colored spots cracks and the sawdust like coatings fall out or protrude showing the location of the worm. The earlier the worm is detected the better, as it is more easily removed when young, and less injury is done to the tree. The burrow becomes larger and deeper as the worm grows and can then be best reached by thrusting a stout wire into the hole, or opening it above and pouring in scalding water slowly, until it reaches the insect and kills it. The practice of digging out the larva from a deep channel is not to be recommended, as it does much injury to the tree. A preventive remedy is the best if an effective one can be found. Various substances have been applied to the trunk of the tree to

prevent the beetle from depositing eggs. Entomologists are agreed that alkaline washes are the best. The following are cheap and effective remedies: Reduce soft soap to the consistence of a thick cream by adding a strong watery solution of washing soda. Lime is sometimes used with the soap and glue may be added to give adhesiveness. A solution of soap and carbolic acid has been highly recommended. Whatever solution is used should be applied thoroughly to the base of the tree and to the trunk as high as the crotches. The best time to make the application is during dry warm weather, so the solution will thoroughly dry before a rain. There should be two applications, one early in June and another early in July. The solution may be applied with an old broom or a whitewash brush.

The natural enemies of this insect are few. Woodpeckers are said to destroy them.

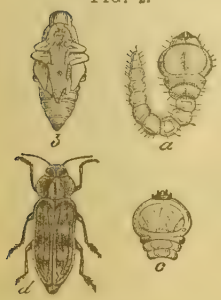
FLAT-HEADED APPLE-TREE BORER.

Chrysobothris Femorata, Fabr.

This pest is very common in Maine, and the injury attributed to the *round-headed borer* is frequently due to it.

It is a native of America and besides being the worst borer affecting the apple tree is known to attack the pear, plum, and peach; also the oak, box alder, hickorys, and maples. It loves the light and may frequently be seen about the orchard on the trees. It is very active and hard to catch, quickly taking wing.

FIG. 2.



Chrysobutheris femorata, Fabr. Flat-headed Apple-tree borer; a, larva; c, head of larva, underside; b, pupa; d, beetle.

DESCRIPTION.

Perfect insect—a beetle variable in size but usually about one-half inch long—oblong flattish in shape—of a dark, dull greenish color with a coppery reflection—under side and legs brilliant coppery color—feet green. On each wing case are two irregularly oblong impressed transversed spots of deeper copper color than the remainder of the wing, dividing the wing cases into nearly three equal portions. The upper surface appears as though sprinkled with an ash colored powder. The beetle somewhat enlarged is shown in (Fig. 2, d.)

Eggs—pale yellow, varied, with one end flattened, irregularly ribbed and 0.02 of an inch long.

Larva—soft, flesh-like, pale yellow; head small, deeply set; jaws black; third segment twice as broad as any of the posterior ones, and bearing on its upper surface a large oval callous like projection covered with numerous raised brown points. (Fig 2, a and c.)

Chrysalis—lighter colored than the larva and with transverse rows of minute spines on the back and a few at the extremity of the body (Fig. 2, b.)

LIFE HISTORY.

The beetle makes its appearance in June or July in our latitude and lays probably about one hundred eggs. The female fastens the eggs, singly or in groups, to the loose flakes of bark or in the crevices, by means of a glutinous substance. The eggs soon hatch and the young worms gnaw through the bark and live on the sap wood making flat channels next to the bark, sometimes girdling the tree. As they get older they bore upward into the solid wood and when ready to change to the *chrysalis* gnaw to the bark and nearly through it. It then changes to the chrysalis (Fig. 2, b), and in about three weeks the beetle comes forth. The larva attacks the trunk and larger branches and is supposed to remain in the tree but one year.

REMEDIES.

Examine the trees early in the fall for dark flattened spots, exudation of sap, or sawdust-like coatings, and if found remove the worm with a knife.

Catch and kill the beetles when possible. Paint the *trunk* and *larger branches* with the solution recommended for the *round-headed borer*.

Keep the trees as vigorous and healthy as possible as this borer prefers sickly trees and those recently transplanted or too severely pruned.

Remove the flakes and moss from the trunk and keep it as smooth as possible. This beetle is said to be worse in high, sandy soil than in rich, low ground. Anything that tends to give vigor to the tree lessens the danger of attack.

FIG. 3.

This pest is held in check by woodpeckers and insect parasite. Several species of four-winged flies called Ichneumons are known to prey upon the larva. In Fig. 3 is shown one of these parasites magnified, the crossed lines showing the natural size.

THE OYSTER-SHELL BARK-LOUSE.

Mytilaspis pomorum, Bouchè.

This pest is quite common about Orono, and letters have been received during the season regarding it from other parts of the State. It is a native of Europe introduced into this country on nursery stock nearly a hundred years ago, and is now widely distributed, doing great damage to the apple tree, and is known to affect the pear, plum and currant. It can be detected with the naked eye as minute brownish or greyish scales nearly the color of the bark. These scales are about one-sixth of an inch long, shaped somewhat like an oyster shell, and placed on the branches or twigs lengthwise with the small end usually upward. (Fig. 4.)

FIG. 4.

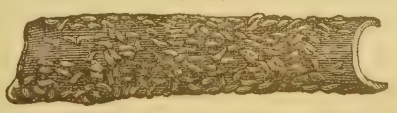
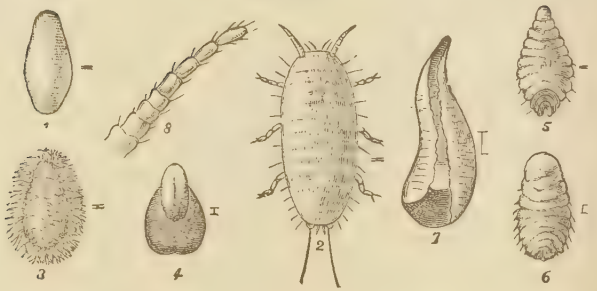


Fig. 5-7 shows the under side of the female scale enlarged. As shown in the figure the bark is sometimes densely covered with the insects, producing great injury to the tree.

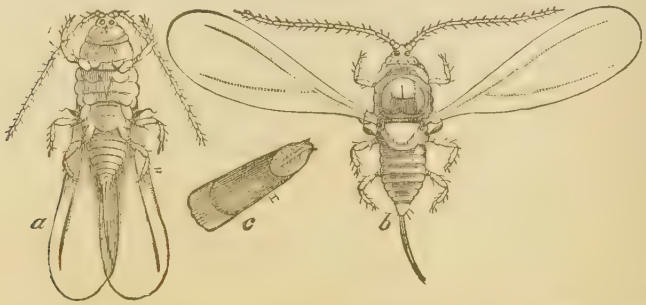
FIG. 5.



DESCRIPTION.

Perfect insect—The female louse is shown much magnified (Fig. 5-2.) The real length is about one hundredth of an inch, and they appear to the naked eye as mere specks. The *male* insect and its scale are shown in Fig. 6, much magnified.

FIG. 6.



The scales of the male are much smaller than the female scales and occurring more commonly on the leaves, are rarely seen. Eggs from twenty to one hundred are found under each scale. Early in winter they are white but toward the hatching time change to a yellowish hue. Fig. 5, 1, shows the egg much magnified. The eggs remain under the scales unchanged for nearly nine months, there being but one brood each season in the Northern States.

LIFE HISTORY.

Female.

The eggs hatch late in May or early in June. If the weather is cold the lice remain under the scale until warmer weather, and these may be seen running about the twigs for a location to attach themselves.

The most of these soon fix themselves around the base of the side shoots of the twigs by means of their tiny, slender beaks and live upon the sap of the tree. They gradually undergo changes shown in Fig. 5, 3, 4, 5 and 6. Before the close of the season the louse secretes the scale under which it lives and perfects itself.

By the middle of August the female becomes a bag of eggs, which are deposited in a mass under the scale, the body of the louse shriveling, as the eggs are laid, until it is a mere speck at the small end of the scale. These eggs remain under the scale, if not destroyed, until the following spring and then hatch, completing the life history.

How this pest is spread from tree to tree is not well made out, but it is supposed that birds carry them on their feet and that large insects may transport them, or that the wind may blow them about. They are probably introduced into young orchards on the nursery stock and multiply.

REMEDIES.

Inspect carefully the nursery stock before setting and remove any scales that may be found. During the winter, examine the trees in the orchard and scrape off the scales found on the larger branches and twigs. In the spring watch for the young lice which may be seen crawling about on the twigs, and then brush the tree with the soap and soda solution mentioned for the borers, or spray the tree with a solution of one-half pound of soda to a pail of water.

This pest is held in check by quite a number of insect parasites. At least four small Chalcid Ichneumon flies are known to prey upon it. A species of mite so small that it can hardly be seen without a lens preys upon the louse and its eggs, and has done much to hold it in check. The lady bird shown in Fig. 7, and its larva eat large numbers of the lice. (This small beetle has black wings with a blood red spot on each. The lava is a grayish worm covered with bristles and very active.) Insectivorous birds are supposed to eat some of the lice and their eggs.

THE APPLE-TREE TENT CATERPILLAR.

Clisiocampa Americana, Harris.

This insect has been very abundant the past season. As many as a dozen webs were counted on a single tree. The insect and its web

are so conspicuous it is not difficult to keep it in check. There is no excuse for allowing the trees to be stripped of their foliage before the colony is destroyed.

The apple-tree tent caterpillar is a native of the northern Atlantic States and has been distributed to other parts of the country on nursery stock. It is now widely known and feeds upon the foliage of the plum, black cherry, apple and other trees.

FIG. 8.

FIG. 9.

DESCRIPTION.

Perfect insect—a moth of a pale dull reddish or reddish brown color. The fore wings are crossed by two oblique parallel dirty white lines. The female is larger than the male. Their relative size is shown in Figs. 8 and 9. The male has feathery antennæ. The moth has no power of taking food and lives only a few days. Its office is to lay the eggs.

Eggs—from one to two hundred in number are laid, in clusters, composed of from ten to twenty rows, upon the smaller twigs. The eggs are conical about one-twentieth of an inch long. The clusters are covered over with a tenacious varnish that keeps out the rain. Fig. 10 shows an egg cluster with the varnish on, and Fig. 11, c, shows the arrangement of the eggs on the twig.

FIG. 10.

Larva—The young larva are fully formed—the eggs in the fall remain dormant until the first warm days of spring and then hatch. They can be made to hatch in the winter by bringing the clusters to the fire. When first hatched they eat the gummy portions of the egg cluster covering, and if the leaves have not appeared can go several days without food. Worms hatched last spring in the house wandered about the twig for over a week before they died, after having eaten all the varnish, leaving the egg-shells bare. The larvæ early begin to construct their web which is increased in

size by additional layers of silk as the worms grow, until it is sometimes ten inches or more across. The worms remain in the tent at night during stormy weather and when not feeding, unless the weather is warm when they may be seen upon the outside literally covering the web. They march in military order twice a day from the nest to feed, once in the morning and once in the afternoon. They pave their roads with silk and follow along them to the leaves. When mature each worm will consume two leaves a day and an average of five hundred leaves would be required for a colony. There are often several webs in a tree. The effects are to rapidly defoliate the tree and draw heavily upon its vitality to produce new leaves. The caterpillars require about six weeks to mature and are then about an inch and three-fourths long, and have the appearance shown in Fig. 11, a and b. The worms have a "white line along the back; then a yellow line dotted with black; then a black stripe marked with blue and yellow dots; then a wavy yellow line dotted with black; then a blue stripe dotted with yellow; then a broken white line; head black; under side of body black; the body covered with yellowish or whitish hairs."

FIG. 11

11

When mature, the larvæ leave the tree and wander about in search of a place to spin their cocoons. They prefer the loose bark of trees, the under side of fence caps and will enter sheds and porches and climb the sides of houses and transform under the edge of clapboards, window caps and eaves. When the orchard is near they become a nuisance by entering the house.

Cocoons—Oblong oval, light yellow formed of a loosely woven outer covering and a dense tough inner coat. The lava en-

closed becomes a brown chrysalis and in about two to three weeks the moth comes forth. The cocoon is shown in Fig. 11, d.

LIFE HISTORY.

The moths appear early in July and in a few days lay their eggs upon the twigs as described above. Early in the spring when the buds are opening, the eggs hatch. The caterpillars live on the leaves and require about six weeks to mature. They then spin their cocoons from which the moth emerges in two or three weeks completing the life history.

REMEDIES.

Pick off the egg clusters during the winter. Should any colonies hatch in the spring as soon as the web is noticed, remove it late in the evening or early in the morning when the caterpillars are at rest. The nest may be reached with a ladder and taken off with a gloved hand and the larva crushed; or a bunch of rags can be tied to the end of a pole and the nest removed. The orchard should be examined from time to time for a month or six weeks. The worms should be killed or they will climb the trees again. This pest has quite a number of natural enemies which keep it in check.

A minute Ichneumon fly only one twenty-fifth of an inch long is parasitic on the eggs. One cluster of eggs examined last spring hatched only about a dozen caterpillars and in a few days nearly seventy-five of these small Ichneumon flies emerged.

FIG. 12

Fig. 12 represents a large Ichneumon fly that preys upon the caterpillars. We hatched last spring from a cocoon an Ichneumon fly shown in Fig. 13.

FIG. 13.

There is shown enlarged in Fig. 14 a species of two-winged fly known as a *Tachina fly*, which preys upon its caterpillars.

FIG. 14.

The above parasites deposit their eggs in the eggs, or upon, or within the bodies of the living caterpillars, destroying them. Several species of the ground beetles prey upon the caterpillars.

FIG. 15.

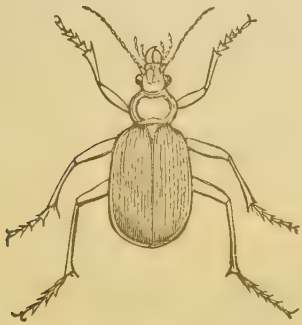


Fig. 15 represents one of these, the Green Caterpillar Hunter, which may be distinguished by its large size and bright green wing covers.

FIG. 16.

In Fig. 16 is shown the Copper-Spotted Colisoma, which feeds upon the caterpillars. It may be known by its large size and three rows of copper-colored spots on each wing cover.

There is a mite similar to the one that eats the eggs of the Oyster-shell Bark-louse that feeds upon the eggs of this species. Insectiverous birds eat the larva. This season we noticed the White-eyed Vireo capture and eat eight half-grown caterpillars at one feeding. It would approach the tent and while on the wing seize a caterpillar and retire to a branch close by and eat it, and soon return again.

FOREST TENT CATERPILLAR.

Clisiocampa Sylvatica, Harris.

This species closely resembles the tent caterpillar of the apple tree, and like it constructs a tent. They are often found on the same tree in the orchard. This insect feeds on the hickory, walnut, rose, oak, poplar, ash and other forest trees and also on the apple, plum, peach and cherry. It is a voracious feeder and does much damage to the foliage of forest and fruit trees.

DESCRIPTION.

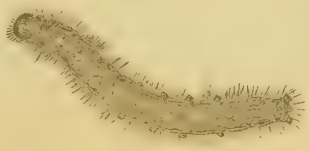
Perfect insect—A moth which expands an inch and a half or more. Wings, brownish yellow. The fore wings with two oblique lines as in the apple-tree tent caterpillar, but brown instead of white and the space between them darker than the rest of the wing. Fig. 17, b.

FIG 17.

Eggs—White—one twenty-fifth of an inch long, tapering toward the base; margin at the top rimmed-centre with a depressed spot; deposited around the twigs like the eggs of the above species and distinguished from them by the cluster being square at the end and uniform in diameter; clusters contain three or four hundred eggs. (Fig. 17, a) shows an egg cluster. (Fig. 17, c and d) eggs, both magnified. The eggs are stuck together and to the twig by a brown varnish.

Larva—Pale blue tinged with only greenish low down on the sides and everywhere sprinkled over with black points and dots. Along the middle of the back is a row of white spots and on each side of these an orange yellow or tawny reddish stripe, and a pale cream yellow stripe lower down on each side. These stripes and spots are margined with black. Each segment has two elevated black points on the back from each of which arise four or more coarse black hairs. Back clothed with fox colored hairs, sides low down clothed with whitish hairs. Head, dark bluish freckled with black dots and clothed with black and fox colored hairs. Legs black, clothed with whitish hairs.

FIG. 18



When full grown, the larva spins a cocoon closely resembling that of the ordinary tent caterpillar. They usually spin the whitish yellow cocoon in the shelter of a leaf, but if leaves cannot be had for shelter

they are placed under loose bark of trees, about fences or under rubbish. The *chrysalis* is formed in the cocoon in two or three days and is of a reddish brown color, densely clothed with short pale yellowish hairs.

LIFE HISTORY.

The eggs hatch about the time the buds burst and like the previous species the larva can go for some time without food. While young, they spin a slight web upon the trunk or branches which is not usually noticed. The larva while young manifest a propensity to military movements, marching about in single or double file, and when older wander about for exercise and food. They become full grown in six weeks and soon spin a cocoon, as mentioned above, from which the moth appears in two or three weeks and soon lays its eggs, completing the life history.

REMEDIES.

Pick the egg clusters in winter. Knock the trees and the young larva will suspend themselves by threads and can be removed by swinging a stick to which the threads become attached. Put cotton bands about the trunks to keep the wandering caterpillars from ascending other trees. The natural enemies are numerous and hold them in check.

FALL CANKER-WORM.

Anisopterix pometaria, Harris.

The eggs and female of this species were received at the station this sea-on. The female was taken in the act of depositing eggs on an apple tree. The moths were quite plentiful about Orono last fall This species has been known for a long time to feed on the foliage of the apple tree, and also to attack the elm, cherry, peach, &c The females being wingless and not being able to travel far, this pest is usually local in its attacks. Whether it does much damage in Maine we do not know, but regard it important that its habits be known.

DESCRIPTION.

Perfect insect—(Male.) A moth provided with wings, the fore wings, brownish gray, glossy, crossed by two whitish irregular bands, the outer one enlarging into a large pale spot at the apex.

Hind wings greyish brown with a white band crossing them, and in the centre a faint blackish dot. Fig. 19, a.

Female—Wingless; uniform shining ash color above, gray beneath; length three to four-tenths of an inch. The female has a sluggish movement and a spider like appearance.

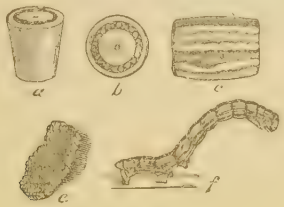
FIG. 19.

Fig. 19, b. represents the female natural size.

Eggs—Grayish, flattened above, with a central puncture and a brown circle near the border. Each female lays 100 or 200 eggs in rows arranged in clusters on the twigs or branches, usually in exposed situations.

In Fig. 19 d. and Fig. 20 e. are shown egg clusters natural size. The eggs magnified are shown in Fig. 20, a. and b.

FIG. 20.



Larva—Pale olive green when young, but varying in color, when grown, from greenish yellow to dark brown. Dorsal band broad, brownish; lateral lines three, white, the middle one paler; broad brown bands below the lateral lines, and below that a broad white band. Under side, flesh-colored; head brown.

These caterpillars belong to the group of inch or measuring worms, because they alternately loop and extend the body in moving. When at rest they sometimes assume the position shown in Fig. 20, f. and can hardly be told from twigs. Fig. 20, c. shows one of the segments of the body magnified, and Fig. 20 f. the larva full grown. When full grown they are about one inch long. When mature they crawl down the trunk or let themselves to the ground

by a silken thread, and burrow to a depth of from two to six inches. They make a tough cocoon of buff colored silk interwoven with earth, and in twenty-four hours turn into the chrysalis.

The *Chrysalis* are light grayish brown and about half an inch long. The *male* slender and provided with wing cases; the female larger and without wing cases.

LIFE HISTORY.

The eggs hatch about the time the buds on the apple trees expand. The young worms feed upon the tender leaves, seeking shelter within the expanding flowers or buds when the weather is wet or cold. They eat holes in the leaves while young, but when older devour the whole pulp of the leaf leaving only the veins and midrib. They feed for about four weeks, and when plentiful so destroy the foliage as to give the trees the appearance of having been scorched with fire. They have done great damage to foliage trees along highways. While letting themselves down to the ground they are often swept off by carriages and carried long distances.

The larva enter the ground, spin a cocoon, are converted immediately into the chrysalis state, from which, during the fall, winter and following spring they emerge in the perfect form, completing the life history.

REMEDIES

Destroy the egg clusters when seen. Kill the moths when found about the orchard. Jar the trees and destroy the larva that suspend themselves by threads.

Prevent the wingless females from ascending the trees, and the larvæ from descending or ascending. This may be done by means of sticky substances bandaged to the tree, by troughs filled with oil, or by collars of metal, wood or glass fastened to the tree and sloping downward like an inverted funnel. Among the sticky substances that have been used are included tar mixed with oil, refuse molasses, printer's ink, lard and sulphur and slow drying varnishes. The best way to apply these is to put them on a strip of stiff paper or canvas six inches wide tied by the middle around the tree a few inches above the ground.

Troughs can be made of rubber, tin or lead, and put around the trunk and kept full of oil. A good collar can be made from a tin band somewhat larger than the trunk, to the top of which is attached

a piece of cotton cloth by which it is fastened to the tree making an inverted funnel.

Whatever apparatus is used care should be taken to stop any holes made by irregularities of the bark or trunk. Cotton batting, straw or rags can be used for this purpose. When sticky substances are applied they should be renewed occasionally during the time the moths ascend or the larva descend. This involves considerable time but pays

Fall plowing has been recommended to expose the cocoons to the weather and birds. Hogs are said to root up the chrysalis and eat them.

Canker worms are preyed upon by a species of mite, by ichneumons, a tachina fly, a wasp, a soldier bug, and by several species of pedaceous beetles, which help hold them in check Insect eating birds devour them.

THE EYE-SPOTTED BUD-MOTH.

Tinetocera Ocellana, (Schiff).

Attention was called last spring to an insect doing injury to the terminal buds of apple trees in the college orchard, and about a hundred larvæ were taken from a single tree, part of which were allowed to transform and proved to be the species named above. We also noticed in the orchard of Mrs. A. A. Sutton of Orono several young trees so badly affected by this insect that nearly all the terminal cluster had turned brown. If as plentiful elsewhere it must do considerable damage. It does not confine its depredations to the leaf clusters but will attack the flower clusters and even the newly-formed fruit; also the small twigs from which the blossoms come, tunneling them down the center, causing their death. It does not confine its mischief to the apple, but attacks also the cherry and plum.

Perfect Insect—A moth of an ash gray color which expands half an inch. Fore wings banded across the middle with whitish gray, and each wing bearing two small eye-like spots, one near the tip, composed of four little black marks on a light brown ground, the other formed of three minute black spots arranged in a triangle and located near the hind angle. Hind wings dusky brown. The moth natural size is shown in Fig. 21.

Eggs—We do not know the eggs of this species but presume they are laid by the moth on the twigs or terminal buds and hatch early in the spring.

Larva—Three-fourths of an inch long, cylindrical, naked, pale dull brown, body bearing warts from which arise fine short hairs; head and top of next segment black. The larva occupies a dry blackened leaf, portions of which are drawn together so as to make a case which is lined with silk. Within this case the larva changes to a dark brown chrysalis in June. The larva is shown in Fig. 21.

LIFE HISTORY.

Eggs laid on the terminal buds or twigs in the summer and remains until the next spring hatching about the time the leaves expand. The larvæ attack the terminal leaf clusters, flower clusters, young fruit or twigs and feed upon them until full grown in June when they spin a cocoon within the case and emerge the perfect moth early in July, completing the life history.

REMEDIES.

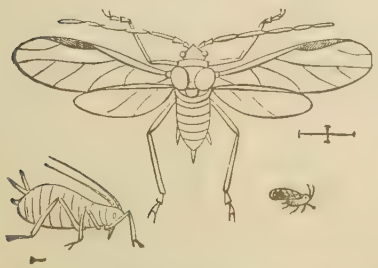
Hand pick the clusters of injured leaves which can readily be seen on the trees in June, being changed in color, drawn together by silken threads. Spraying the trees, for the codling moth would probably destroy this insect.

THE APPLE-TREE APHIS.

Aphis mali, Fabr.

Several complaints have been received the past season of depredations by the above species, and we judge it is quite widely distributed in the State. It is an insect that feeds upon the juices of the foliage and when at all abundant must seriously affect the vitality of the tree. This insect was originally from Europe, but is now a pest in apple orchards throughout the Northern United States and Canada. *Perfect insect* (*male*) head, thorax and antennæ black, neck usually green; abdomen, short, thick, oval, bright green; sides with row of black dots; nectaries and tail-like appendages black; wings transparent with dark brown veins. The *winged female* resembles the male in color. Perfect insect (*wingless female*)—length less than one-tenth inch; body oval, pale yellowish green, often striped with deeper green; eyes and tail appendages black; honey tubes green.

FIG. 22



The winged male and wingless female are shown highly magnified in Fig. 22. The real size is indicated by hair lines.

Eggs—Minute, oval, light yellow or greenish when first laid but gradually change to shining black.

Young insects—Produced alive, nearly white when born but soon become yellowish green.

LIFE HISTORY.

The eggs are deposited in the autumn in the cracks of the bark of twigs and at the base of the buds. The eggs hatch when the buds begin to expand and the lice locate themselves on the young buds and leaves by means of their beaks and feed upon the juices. The spring brood is composed of females and is about ten days reaching maturity. Each louse gives birth to living young, producing about two a day for two or three weeks and then dies. These young become mothers in about ten days and produce. This process is continued through the season, there being many generations mostly wingless females, and without the appearance of males. Winged females are sometimes produced and migrating to other trees spread the pest. Late in the season males are produced with the females and eggs are laid to perpetuate the species, thus completing the life history.

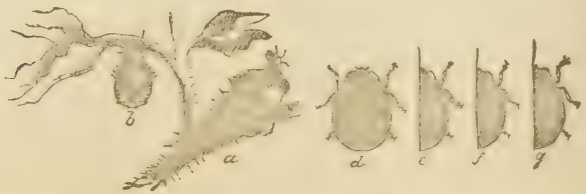
REMEDIES

Spray the trees, about the time the buds are expanding, with strong soap suds, or a decoction of tobacco stems or leaves one pound to a gallon of water. Spraying the tree for the codling moth with Paris Green would probably destroy some of the plant lice. The presence of plant lice is indicated by ants which ascend the trees to feast upon the honey-dew secreted by the lice. The plant

lice have two projections, one from each side of the hinder part of the body, called nectaries or honey tubes from which a sweet fluid is secreted in some quantity. Ants gather in great numbers to feed upon it and will even strike the lice with their antennæ causing them to give out the fluid. The normal use of this fluid is probably to feed the young lice.

The natural enemies of the plant lice are many. Several species of lady-birds prey upon them. One of these, the Fifteen-spotted Lady-bird is shown in Fig. 23, where the larva (a), chrysalis (b),

FIG. 23.



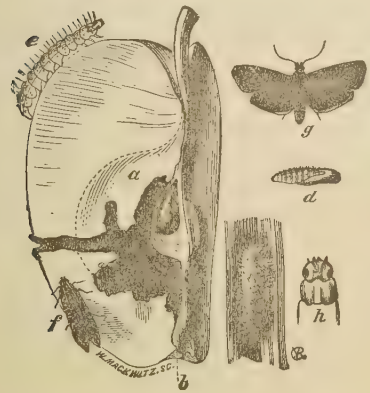
and several forms of the perfect insect (d, e, f, g) are represented. The larva of the Lace-winged or Golden-eyed Flies feed upon the plant lice. These flies may be known by their light green gauzy wings and offensive odor when disturbed. Their eggs are raised on little stalks and are found in clusters. The larva of the Syrphus Flies also devour plant lice. These flies deposit their eggs among the plant lice and the blind larva hatched from them wander about devouring any lice they chance to meet. These flies may be known by their black color, clear wings and yellow stripes crossing the body. A tree affected by plant lice can be distinguished by the twigs and leaves being distorted and twisted backward. The lice find shelter under the distorted leaves. Scraping the loose bark from the trunks and branches in the winter and washing with soap suds will help destoy the eggs.

THE CODDLING MOTH.

Corpocopea Pomonella, (Linn.).

The habits of this pest are too well known to need detailed description. We give a figure which shows the perfect insect (g)

FIG. 24.



expanded and the same with closed wings at (f). The larva is shown at (e) full grown. At d. is shown the chrysalis; at (i) the cocoon, at (h) the head of the larva enlarged. The entrance of the larva at the colyx of the apple is shown at (b). The dark shaded portions of the figure represent the borings of the larva and the hole at the side the place where the full grown larva escaped.

LIFE HISTORY.

First Brood.—The eggs are laid singly in the eye of the apple when about the size of a pea, or occasionally at the stem end or even on the cheek. Sometimes two or more larvæ occupy the same fruit. The eggs hatch in about a week and the larvæ bore toward the core, feeding upon the material round it, finally escaping through the side. The larva requires about four weeks to mature. The fruit affected falls prematurely. If the larva attains its growth before the fruit falls it lets itself to the ground by a silken thread or crawls down the branches to the trunk. Those that let themselves down or fall with the fruit generally crawl along the ground to the trunk where they with the others conceal themselves in the crevices or cracks of the bark, spin a cocoon which they cover with small pieces of bark or other available material. The change in the chrysalis takes place in about three days. The moth emerges in about two weeks, is capable of laying about fifty eggs, which are deposited from time to time for two weeks or more.

The *Second brood* is generally on the wing the latter part of July. The moths of the first brood not appearing all at the same time and the great length of time required for the female to lay her eggs would give larva of all ages and cause the broods to lap over each other. The second brood generally deposit their eggs in the late apples and if the larva are matured before gathering time they leave the fruit and spin cocoons as mentioned above, but when taken to the cellar they spin their cocoons between the staves and hoops of the barrels or about the bins.

The fall brood remains in the larval form within the cocoon until spring, when it emerges, completing the life history.

It would seem from the investigations of Mr. Charles G. Atkins, recorded in Agriculture of Maine, 1883, p. 356, that in this State we sometimes have but one brood of the Codling Moth. My observations the past season indicate two broods, lapping over each other so as to indicate that eggs are deposited in July, August, September and the first part of October. Larva one-half grown were found in November.

REMEDIES.

The modern and perhaps best way to hold in check this pest is to spray the trees, about the time the apples are forming, with Paris Green suspended in water, by means of a force pump. There should be at least two applications covering the time of emergence of the moths and the period of laying eggs. If there is but one brood or only a feeble second brood this method would be more efficient in Maine than where two broods occur. As most of the larvæ escape from the apples before they fall, the custom of gathering windfalls to destroy this insect cannot prove effectual, though it is recommended as a help. The apples should, however, not be allowed to remain long on the ground. They harbor the larvæ of other insects which would be destroyed at the same time.

About the first of June fasten around the trunks of the trees bandages of straw, cloth or paper. The larvæ will seek these bands to spin their cocoons. The bands should remain until after the second brood spins and be examined for worms and cocoons every few days. The bands should also be used when spraying is done as a means of destroying the second brood should it appear.

Barrels in which apples have been stored should be examined and the cocoons destroyed. The natural enemies are few, though ichneumon flies, ground beetles and other insects and insectivorous birds, help keep them in check.

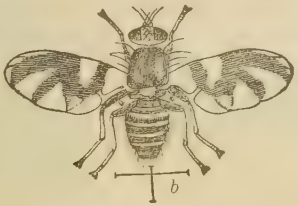
THE APPLE MAGGOT.

Trypeta pomonella, Walsh.

Extensive observations were made the past season on this troublesome insect and considerable knowledge gained of its life history. As our investigations are not completed we defer an exhaustive consideration until another time.

That the two-winged fly which lays the eggs may be known we figure it and describe it.

FIG. 25.



The perfect insect is a two-winged fly from one-fifth to one-fourth inch long, and is easily recognized by the black bands across the wings, the rust-red head, black eyes, white spot on the back part of the thorax and white bands on the abdomen. The female is shown enlarged in Fig. 25. The flies appear on the wing in July in this region. The minute larvæ, just hatched, were observed about August first, when the apples were nearly an inch in diameter. We would like to have those who are interested in the matter note the appearance of this fly and report, sending live specimens if possible enclosed in a small bottle or box.

REMEDIES.

As the larvæ go through their transformations near the surface of the ground and often do not enter the ground at all but hide under sticks and about the roots of grass it would seem that plowing would destroy a great many by covering them so deep they would not be able to reach the surface. The larvæ do not leave the apples before the windfalls drop, and therefore the gathering of them would destroy a great many.

We do not think spraying when the apples are small, as is done for the Codling Moth, would do any good as the fly does not deposit its egg until the apples are of considerable size.

To leave the apples of affected trees ungathered, or to turn upon the ground those found to be infested would multiply the pest.

ASH-GRAY PINION.

Lithophane antennata, (Walker.)

Though not abundant we found quite a number of apples the past season apparently injured by this insect. The perfect insect is a moth. It is the larva that does the injury by boring into the the young fruit.

FIG. 26

In Fig. 26 is shown the moth and the larva at work. The moth is dull ash-gray color with variegated fore wings. The larva pale green, spotted with cream color and with a broad lateral band of the same shade. Hand picking is the only remedy we know or can suggest.

THE PEAR TREE SLUG.

Selandria cerasi, Peck.

Specimens of the above insect were received the past season and reported as doing great injury to the foliage of cherry and plum trees. Mr. Eben Bickford of South Newburgh says, "they appeared on my cherry trees about ten or twelve years ago and destroyed my trees in two or three years. *Eternal vigilence* has been the price of cherries since. I have found no one who has seen anything like them, and I send them to you in hopes you will be able to name them and suggest a remedy. They will live on and destroy Damson plum trees when they cannot get cherry, but I have not seen them on any other. They do not travel far, as my neighbors, only twenty or thirty rods off, do not have them."

This pest was fully considered in 1790 by Prof. Peck of Mass., in an article entitled "Natural History of the Slug worm" which

was awarded a premium of fifty dollars and a gold medal by the Masssachusetts Agricultural Society. This insect has spread over the greater portion of the United States and Canada and feeds upon the foliage of the pear, quince, plum and cherry doing more or less injury. Though called the pear slug it seems to prefer the foliage of the cherry.

FIG 27.

FIG. 28.

DESCRIPTION.

Perfect insect—A four-winged fly of a glossy black color. The wings are transparant with brownish veins and the fore wings crossed by dusky markings; legs dull yellow with black thighs, excepting the hind pair which is yellow in the middle and black at the extremeties. The female is about one-fifth inch long and the male smaller. The perfect insect is shown in Fig. 27, enlarged.

The eggs are small and deposited singly within semi-circular incisions made in the skin of the leaf upon the upper or under side.

The larva or slug when grown is about half an inch long, slimy, blackish or olive brown; head end smaller; head small, reddish, and nearly concealed under the first segment of the body. The young larva is white, but soon becomes olive colored and slimy. The last time it molts it elongates, loses it slimy appearance and becomes clear yellow or reddish yellow, and soon crawls or falls to the ground, buries itself from one to four inches and changes to the chrysalis stage. It does not spin a cocoon but forms an oval cavity in the earth and cements it together with slime, thus forming a chamber within which it transforms. The larva is shown natural size and enlarged in Fig. 28.

LIFE HISTORY.

The flies appear the last of May or early in June and deposit their eggs as described above. The eggs hatch in about two weeks. The slugs change their skin four or five times and come to maturity in about a month, crawl to the ground, change to chrysalis state,

from which the flies emerge in two weeks. These flies immediately lay eggs for a second brood, which hatches early in August. These larvæ mature in due time, enter the ground where they remain during the winter and emerge the following spring, completing the life history.

REMEDIES.

The flies feign death when disturbed and can be shaken from the trees and caught on cloth and destroyed. The best time to shake trees is early in the morning or late in the evening.

Spray the trees with hellebore and water, one ounce to a pailful. Dust the trees with air-slacked lime. Sand, ashes and road dust seem to be of no value. If the trees are not bearing, the first brood could be killed by spraying with Paris Green and the second brood could always be killed that way, as the larva hatch after the fruit is gathered. The slugs are so slimy and have such a disgusting odor they are not eaten by birds and have few natural enemies, though the maggot of a small species of ichneumon fly is parasitic on the eggs. These flies are usually local in their injuries and much more common some years than others.

THE PLUM CURCULIO.

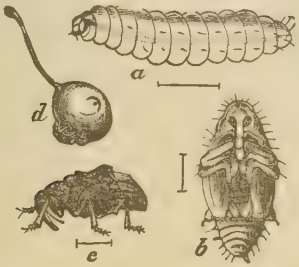
Conotrachelus nenuphar, Herbst.

This insect which is well known as the worst enemy to the plum grower was observed the past season as doing considerable damage to the apple. From ten to twenty-five per cent of the early apples examined in July showed the characteristic cut of this insect.

Quite a large number of apples of the earlier varieties examined for the apple maggot were found punctured and infested by the larva of the above species. After the first of August the cuts we found made by this insect were few and we are led to believe they prefer the earlier varieties and that the apples punctured do not mature. We found also that a very large per cent of the larvæ which hatched did not reach maturity, as quite a number of dead larvæ were found in the fruit and but very few reached maturity and transformed. We however succeeded in transforming enough to identify the species. It would seem that the plum curculio does not flourish well in the apple and attacks it in the absence of its favorite fruit. The decline in the cultivation of plums due to the ravages of this pest and the black knot will account for its attacking apples.

When the trees are full the apples that are punctured and drop would not lesson the crop, but with light bearers and in seasons when the bloom is scarce the damage would be considerable. This insect is known to infest the plum, peach, nectarine, apricot, cherry, apple and pear. The plum curculio is a native of this country and originally fed upon the wild plums, and still infests them. The males and females both puncture the fruit to feed on it but only the latter make the crescent shaped cuts.

FIG. 29.



DESCRIPTIONS.

Perfect Insect—A beetle belonging to the family of insects known as weavils or snout beetles. It is blackish or grayish, rough, with a black shining hump on each wing case near the middle, behind which, is a dull ochre-yellow band marked with whitish about the middle; each thigh has two small teeth on the under side; snout short. Length of insect about one-fifth of an inch. Shown in Fig. 29 c. enlarged.

Egg—Oblong-oval, pearly white, visible to the naked eye, and can be found readily by examining the crescent-shaped cut made by the female.

Larva—When young, tiny, soft, footless; head distinct, horny. When full grown it is usually of a glossy yellowish-white, but varies in color with the food; head light brown or yellowish, along each side is a light line, below which is a row of black bristles and above it a less distinct one, and toward the hind extremity a few pale hairs; length about two-fifths of an inch. Shown enlarged in Fig. 29 a. The larva is so transparent the internal organs are plainly seen through the skin, imparting a reddish color to the central parts of the body.

The chrysalis is shown enlarged in Fig. 29 b.

LIFE HISTORY.

The beetles hybernate in secluded spots during the winter and appear on the wing about the time the plum trees blossom and, as soon as the young fruit forms begin to deposit their eggs. The female when about to lay an egg makes a minute incision with her jaws and then inserting the snout, enlarges the hole sufficiently to hold the egg, turns around, deposits the egg, thrusts it to the bottom of the hole with the snout, then cuts a crescent-shaped incision around one side of the opening, as shown in Fig. 28, d.

Only one egg is laid in a place, though on the apple, several punctures may occur on the same fruit. Each beetle lays from fifty to one hundred eggs and deposits from five to ten a day. The time of depositing eggs by early and late beetles probably occupies about two months. The first apples examined July first were badly punctured and no new cuts were found after the twentieth of the month. The eggs hatch in a few days and the larva is full grown in from three to five weeks. The infested apples or plums usually drop to the ground before the larva is grown and when mature it leaves the fruit, enters the ground four to six inches, forms an oval cavity, changes to the chrysalis and in from three to six weeks the perfect insect is formed and makes its way to the surface, completing the life history. There seems to be some reason for believing a few remain in the ground all winter. The specimens we transformed appeared in September, about four weeks from the time the larva was matured. We are inclined to believe that those apples in which the egg hatches and the larva grows, drop early. Abortive cuts shrivel and deface the fruit and check its growth but it may mature.

REMEDIES.

Jar the trees and catch the beetles that fall on sheets spread under the tree. The jarring should begin early, as the beetles appear with the blossoms, and be continued morning and evening for a month, or until the beetles become scarce. Dr. Hull of Illinois devised a "Curculio Catcher" which consists of an inverted umbrella on a wheelbarrow and provided with a slit in one side to receive the trunk of the tree. The machine is provided with a padded bumper in front and is driven against the tree with force enough to dislodge the beetles and cause them to fall into the umbrella from which they are collected and destroyed.

Gather the fallen fruit as soon as it drops or turn hogs in to devour it. Poultry allowed to run in the orchard will destroy a good many. Keep the ground clean under the trees as the beetles hybernate under rubbish. If the ground is clean, chips, pieces of cloth or shingles can be placed under the trees and examined occasionally for the beetles that hide under them. Plum orchards should be as far from groves of timber as possible, as the beetles find shelter in the woods and are apt to be more numerous than in open ground.

Prof. S. A. Forbes in Trans. Department of Agriculture, Illinois, Vol. 23, 1885, p. 26 in the Appendix, records experiments with Paris Green and lime suspended in water to determine their usefulness in protecting the apple from the attacks of the plum curculio; 2418 apples from trees sprayed with Paris Green were compared with 2964 apples from check trees not sprayed, and it was found that 27.3 per cent of those poisoned had been infested by curculios while of those not poisoned 51.3 per cent were affected. This would seem to show that the spraying saved nearly one-half of those that would have been injured. This method has the advantage of destroying a great many codling moths at the same time, as well as other insects. The experiments with lime seemed to show the destruction of about 25 per cent of the curculios, making it less efficient than Paris Green.

Quite a number of insect enemies help hold this pest in check. Among these are two or three species of ground beetles, the larva of the common soldier beetle, larvæ of the lace-wing flies, minute yellow Thrips and two species of ichneumon flies. The larvæ of the ground beetles, soldier beetle and lace-wing flies, and the ichneumon flies, prey upon the larva of the plum curculio. The Thrips mentioned devours the eggs.

THE CHERRY TREE PLANT LOUSE.

Myzus cerasi, (Fabr.)

Specimens of this insect were received the past season with complaints of its doing injury to the foliage of the cherry trees. The leaves and stems sent us were literally black with the lice. This species like all the plant lice multiplies rapidly. Dr. Fitch estimated that there were at least twelve millions of these insects on a single small cherry tree. The life history is essentially the same as that given for the apple tree aphis and the natural enemies and remedies

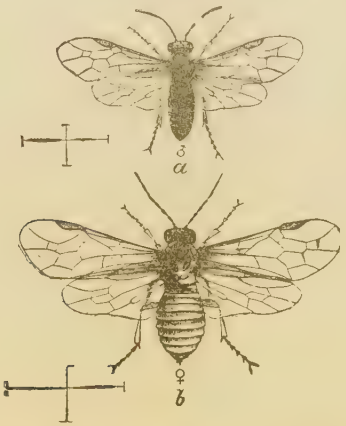
about the same. Spraying the trees with lye, soap suds or tobacco water about the time the leaves are unfolding, and once again later if necessary, would kill the most of them. The spray should be directed under the leaves as much as possible so as to reach them. Spraying with Paris Green early in the season would probably kill the lice as well as other insects. Some have tried colonizing lady-birds upon the trees with satisfactory results.

THE IMPORTED CURRANT-WORM.

Nematus ventricosus, Klug.

Attention has been called to this insect as doing injury to gooseberry bushes. We give cuts of the perfect insect (Fig. 30) which

FIG. 30.



is four winged and known as a saw fly, the larva at work on the leaves (Fig. 31.) and a leaf (Fig. 32) showing the holes made by the young larva.

FIG. 31.

FIG. 32.

The consideration of this and other insects doing injury to currants and gooseberries is deferred, until we have more data. The station will be pleased to receive specimens of insects doing injury to the above plants. Below we give the remedies known for the currant worm. Spray the bushes well with powdered hellebore in water, one ounce to the pailful. Shower the bushes with water a little hotter than the hand can bear and destroy the worms that are dislodged and drop to the ground. Hand pick the leaves when the larvæ are young and grouped on them. The young larvæ are to be found usually on the lower leaves of the bushes and can be detected

by the holes in the leaves as shown in Fig. 31. The application of the hot water would probably destroy a great many plant lice which are said to be doing considerable damage to the gooseberry bushes in the nursery rows in Aroostook county. Several natural enemies keep the currant worms in check. A small ichneumon fly is known to be parasitic on the eggs, and other species destroy the larva.

FIG. 33.

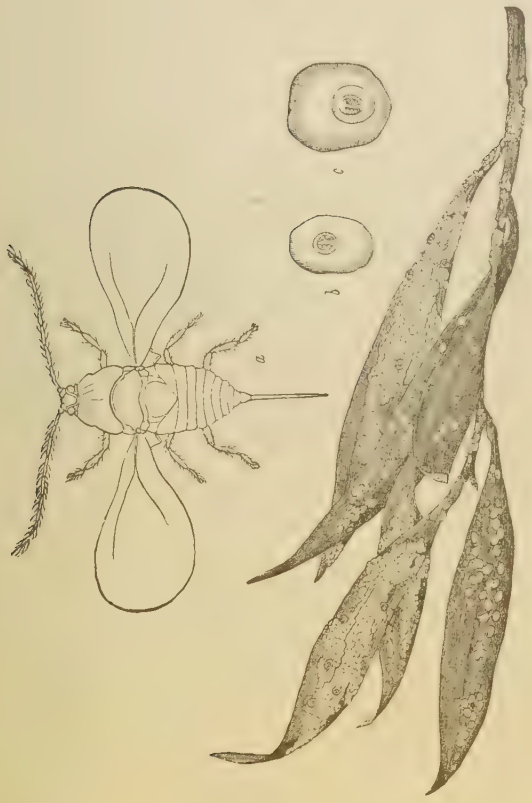
The Placid Soldier-bug shown in Fig. 33, a, enlarged, and natural size below, is known to destroy them. This insect or one related to it is reported by Mr. E. W. Merritt of Houlton, Me., as feeding upon the larvæ, piercing them with its short beak and then sucking them dry. This insect should not be destroyed. It may be known by the following description: Head, thorax and legs black; abdomen, red, with an elongated black spot in the middle, crossed by a white line.

THE WHITE SCALE,

Aspidiotus nerii, Bonchè.

Specimens of this insect were received upon the leaves of the English Ivy. The plants were so badly infested that the leaves were nearly white with the scales. The lady sending the specimens stated that she had some time before placed leaves with the white spots on them, which came from a neighbor's, on a shelf near her plant, which would account for the attack. This insect attacks the orange and lemon trees in Southern California and Florida besides a number of other trees and plants. The Fig. 34 we give shows an acacia twig infested by this insect, the scales showing natural size.

FIG. 34.



The female scale is shown (Fig. 34, c.) enlarged. The real size is about one-twelfth of an inch and the color whitish or light gray.

The male scale (Fig 34, b.) is about one twenty-fifth of an inch long and white with a tinge of yellow.

The winged male is shown (Fig 34, a.) highly magnified. It is yellow, mottled with reddish brown and has transparent wings.

REMEDY.

Wash the stems and leaves with whale-oil soap and water or by means of a sponge apply occasionally a thin coating of kerosene or sweet oil to the leaves and stems.

THE BLACK SWALLOW-TAIL.

Papilio Asterias, Cramer.

The larva of this insect was received from two parties with complaints of its ravages upon parsnips, carrots and celery. It is commonly known as the Parsley worm but feeds upon many plants cultivated and wild that belong to the Parsley family.

DESCRIPTION.

The perfect male insect is a black butterfly with a double row of yellow spots on its back; a broad band composed of yellow spots across the wings and a row of yellow spots near the hind margin; hind wings tailed and have seven blue spots between the yellow band and the outer row of yellow spots, and near the inner angle is an orange spot with a black center. Paler below and spotted with orange. The female has only a few indistinct yellow spots on the upper side of the wings. Expanse of wing three and a half to four inches.

Larva when full grown is about an inch and a half long and of a delicate apple-green or greenish-yellow color above, paler on the sides and whitish below. The body is transversely banded with black, each band bearing a row of six yellow spots. When disturbed the caterpillar thrusts out from the first or second segment of the head, an orange Y shaped organ, which emits a disagreeable odor.

Pupa an inch and a quarter long, pale green ochre yellow or ash gray in color; there are two short ear-like projections above the head. Pupa attached by the tail to a pad of silk and supported across the middle of the body by a loop of silk.

LIFE HISTORY.

The butterflies appear in June and lay the eggs upon carrots, parsnips, celery, caraway and other umbelliferous plants. The worms, after several molts, are mature in about a month, leave the plants and finding a suitable place on a fence, building, or trunk of a tree, make the silken pad and loop, and in a day or so changes to the pupa. In from nine to fifteen days, depending on the weather, the butterfly emerges, and in due time lays eggs which hatch. These larvæ mature and enter the pupa state in the fall and remain in this condition until the following spring, when the butterflies emerge, completing the life history.

REMEDIES.

Hand pinch the larvæ and pupæ and destroy them. Chickens and insectiverous birds will eat them.

THE EYED ELATOR.

Alans oculatus (Linn.)

We received from Mr. E. W. Shepherd of Jefferson, Me., the past season what seems to be the half-grown larva of the above species, said to have been taken from the trunk of a small apple tree. This insect belongs to the spring beetle family, the larvæ of which usually are found under the bark of trees, or boring in decaying wood. To find one boring in sound wood is unusual and for *this* species novel so far as we know. The above species is the largest of the family and the perfect insect is a handsome beetle over an inch long of a grayish color with two prominent black eye-like spots on the thorax. Smaller species of the same family are common and they all attract attention by their power to spring when placed on their back. The above species is not liable to do much injury.

THE HAWTHORN TINGIS.

Corythuca arcuata.

This species was found in abundance feeding upon the foliage of butternut trees in the western part of the State. They are not likely to do much damage and deserve only a passing notice. By cleaning the ground under the trees in the fall and burning the rubbish a great many of them would be destroyed.

THE MOURNING-CLOAK BUTTERFLY.

Vanessa antiopa, Linn.

The larva of this species was quite abundant the past season about Orono and in other portions of the State, feeding upon the foliage of the elm. This species feeds also on the willow poplar but attracts more attention when devastating our favorite shade tree.

DESCRIPTION.

The *perfect insect* is a beautiful butterfly with two and a half to three inches expanse of wing. It may be known by the purplish or reddish brown wings bordered by a yellowish or buff band, within which is a row of violet blue spots. *Eggs* pale yellow and ribbed. A dozen or more are deposited on the stem near the petiole of a leaf.

The *larva* when mature is about one and three-fourths inches long; black, minutely dotted with white and appearing grayish; back marked by a row of eight bright brick red spots. The body is armed with from four to seven stiff branding spines on each segment except the first, giving the caterpillar a formidable appearance. The larva are social in their habits feeding in groups on the foliage. Chrysalis dark brown, with large tawny spots around the tubercles on the back.

LIFE HISTORY.

The butterflies hybernate in some sheltered place and are on the wing in the spring before the snow is gone, and lay their eggs for the first brood, which in this region hatches in June, and the larva are mature late in July or early in August, enter the chrysalis state and the butterfly emerges in ten or twelve days.

This brood soon lays eggs, which hatch and the larvæ mature; enter the pupa state and emerge before fall, producing the hybernating brood, completing the life history.

REMEDIES.

We find but few remedies suggested in the writings of entomologists but see no reason why they might not be destroyed by Paris Green on smaller trees and the branches of larger ones within reach of the spraying pump.

The natural enemies of this insect help to keep it in check. Out of half a dozen chrysalids put away to transform by Mr. Briggs, only two butterflies emerged and from all the others there came numerous small ichneumon flies. From one of the chrysalids over one hundred and fifty came forth. Some of the specimens were sent to Mr. Howard of the Agricultural Department at Washington, and he called them *Pteromalus pupasum*. We do not know of this species having been found before parasitic on the larva of this butterfly, though another species *Petromalus vanessæ*, Harris, with this habit is recorded.

THE MEAL WORM.

Tenebrio molitor.

The perfect insect of this species was received from Mr. George L. Coffin, Winthrop, Me., who "found large quantities in corn meal." The perfect insect is a plain black beetle six-tenths of an inch long. The larva is about an inch long, cylindrical, smooth, glossy, hard, and of a yellowish brown color. It is known to infest corn meal, rye meal, boxed crackers, biscuits, &c., and is often found where grain is stored We know of no remedy for them beyond killing as many of the beetles and larvæ as possible when found.

BENEFICIAL INSECTS.

All insects are not injurious. The indiscriminate killing of insects should be guarded against, as one's friends are as likely to suffer as his enemies. There are a large number of parasitic insects which render great service to the farmer and fruit grower by feeding on injurious insects. These should be recognized when seen, protected and encouraged.

Attention is called to the *lady birds*, ichneumon flies, tachina flies and ground beetles illustrated in this report. The lady birds are small, *turtle shaped* beetles usually with spots on the wing covers. The beetles and their larvæ destroy the eggs of a number of injurious insects. They should be protected. Two forms are shown, Fig. 7 and Fig. 23.

Ichneumon flies have four wings and are related to the wasps and bees. There are numerous minute forms that prey upon the eggs and larvæ of injurious insects, and larger forms that deposit their eggs on caterpillars, destroying them. Figs. 3, 12 and 13, will show the nature of these beneficial insects. The two-winged flies are sometimes parasitic on injurious insects. A tachina fly with that habit is shown in Fig. 14.

The predaceous beetles are carnivorous, feeding upon the larva and perfect form of other insects. They are quick moving beetles with long legs and generally metallic or black color. Two forms are shown in Figs. 15 and 16.

INSECTICIDES.

Experiments have been made the last season with the following insecticides, viz: Paris Green, London Purple, Hammond's Slug

Shot, Peroxide of Silicates, and Doyen's Potato-bug Prevention, to determine their relative value in destroying the potato beetle. The Paris Green was applied with an ordinary water sprinkler, using one teaspoonful to two gallons of water with satisfactory results. The London Purple was applied in the same way, but one tablespoonful to two gallons of water. Results not as satisfactory as with Paris Green. The Peroxide of Silicates and Hammond's Slug Shot were sifted on the potatoes from a small box with a fine wire screen bottom, at the rate of sixty pounds to the acre. The former scorched the leaves. Both killed the beetles. A partial analysis was made of *Doyen's Potato-bug Preventive* but no experiments were performed with it at the station, though some of it was tried about Orono with negative results.

In all of these the poisonous ingredient must be arsenious acid (oxide) or its compounds, so that in each case the value of the preparation as an insecticide is determined approximately by the amount of arsenious acid present. The following are the results of the analyses of the above named materials.

	Paris Green, Per cent.	London Purple, Per cent.	Hammond's Slug Shot, Per cent.	Peroxide of Silicates.	Doyen's Potato Bug Preventive.
Arsenious Oxide (white arsenic)	47.68	55 35	1.20	1.61	19.09
Cupric Oxide	27.47				7.41
Calcium Oxide (lime)	–	26 23	29 41	34 75	
Sulphuric Acid (anhydride)	.78	.22	42.05	49.66	
Carbonic Acid	–	.27			
Acetic Acid	7.16				
"Dead oil" (by difference)*	–	–	5.00		
Insoluble residue	2.34				
Water of hydration (calculated)	–	–	18.91		
Moisture	1.35	5.29	3.43		

*Also determined approximately.

The Paris Green is mainly an aceto-arsenite of copper, or in other words, a compound of acetic acid, arsenious acid and copper. The London Purple is composed mainly of arsenite of lime, contain-

ing, besides, quite an amount of coloring matter. It is quite variable in composition.

Hammond's Slug Shot does not make a good showing as over nine-tenths (exactly 90.37 per cent) of it appears to be nothing but plaster. It contains only 1.2 per cent of arsenious acid, and approximately 5.00 per cent of a heavy oil.

Peroxide of Silicates contains only 1.61 per cent of arsenious acid and 84.41 per cent of calcium sulphate. A large part of the calcium sulphate is anhydrous and may have been added either as the mineral anhydrite or as Plaster of Paris.

Doyen's Potato-bug Preventive contains 19.09 per cent of arsenious acid and 7.41 per cent of copper oxide. The remainder consists chiefly of starch in large fragments. The presence of copper oxide and the green color of the mixture indicate, that the arsenic was added in the form of Paris Green.

Paris Green contains about forty times as much arsenious acid as Hammond's Slug Shot and the London Purple analyzed over forty-six times as much. Peroxide of Silicates is but little better than Hammond's Slug Shot. A mixture equally as strong as Hammond's Slug Shot can be made by mixing two and three-fourths lbs. of Paris Green with one hundred lbs. of plaster, and a mixture as good as Peroxide of Silicates by mixing three lbs. of Paris Green with one hundred lbs. of plaster. The heavy oil in Hammond's Slug Shot is probably no benefit, as the mixture contains enough arsenious oxide to kill the beetles without it.

Doyen's Potato-bug Preventive cannot be compared with the others, as the directions require a different method of application. This insecticide is put up in small wooden boxes holding an ounce and a half of what appears to be merely a mixture of about four parts of starch and one part of Paris Green. It is retailed at the modest sum of fifty cents per box. A similar mixture could be prepared from four parts of flour and one part of Paris Green, at a cost of less than one cent per box. Flour, which is cheaper than starch and just as good, has long been used as a carrier for Paris Green. The novelty of this insecticide is the method of application as shown by the following directions pasted on each box:

"A HALF HOUR'S WORK TO THE ACRE SAVES THE CROP.

Directions for use—Take two tablespoonfuls of the powder and put it into a ten quart pail; then add three quarts of boiling water. Fill the pail with potatoes cut in small pieces; then fill the pail with water so as to cover the potatoes, and let stand over night or longer. Just before the potatoes come up, scatter the pieces over the ground. This is enough for one acre. Price 50 cents."

The millennium in potato raising would certainly be here, if by "a half hour's labor to the acre" at a cost of "fifty cents" we could "save the crop" from the ravages of the "potato bug."

If potato beetles would all come out of the ground before the potato tops appear, and could be assembled to partake of the inviting feast spread for them, their destruction would be inevitable. But as they prefer not to appear much before early potatoes are up, and continue to emerge for a month or six weeks; and as they will fly a long way in search of their favorite food and will not eat the tubers when young tops are to be had, there seems to be great difficulty in fulfilling the necessary conditions. As it might be difficult to induce the beetles to change their tastes and habits probably the safest and most economical plan would be to use the cheaper mixtures of Paris Green and apply them in the ordinary way. This insecticide was tried by two parties at Orono without any apparent "substantial benefit", as the usual applications of Paris Green had to be made later in the season.

RELATIVE COST.

Hammond's Slug Shot, 100 lbs.,	$5.00
Peroxide of Silicates, 100 lbs.,	4.00
London Purple, 2 lbs. 40 cts., 100 lbs. plaster 50 cts. =	.90
Paris Green, 3 lbs. 70 cts., 100 lbs. plaster 50 cts. =	1.25
Paris Green, 2 lbs. 50 cts., 100 lbs plaster 50 cts. =	1.00
Paris Green, 1 lb. 25 cts., 100 lbs. plaster 50 cts. =	.75
Paris Green, ½ lb. 15 cts., 100 lbs. plaster 50 cts. =	.65

Hammond's Slug Shot and Peroxide of Silicates will kill insects effectually. It is not a question of efficiency, however, but one of relative cost. For garden use where only a few pounds are needed many would prefer to pay a good price for an insecticide than to take the trouble to prepare one. Most farmers who use considerable quantity rather buy the plaster and Paris Green and mix them, than to pay three or four dollars per hundred pounds to have it done for them.

In the above table we have for the sake of comparison of cost used two pounds London Purple to one hundred pounds of plaster, and three pounds of Paris Green to one hundred pounds of plaster. Experience shows that these strong mixtures are unnecessary, scorch the leaves and are a waste of material. Economy would suggest the use of as weak an insecticide as possible and yet secure good results.

Hammond's Slug Shot and Peroxide of Silicates contain considerable more arsenious acid than is necessary to kill the beetles.

One pound of London Purple to one hundred pounds of plaster is the strongest mixture advisable and the work can be done with less.

The strongest mixture of Paris Green advised would be two pounds to one hundred pounds of plaster, and there is good reason for believing that one pound to one hundred or even two hundred pounds of plaster, when thoroughly mixed and well applied, is sufficient.

The cheapest and most efficient poison for potato beetles is *Paris Green* applied with plaster or in suspension in water.

If plaster is not useful as a fertilizer on the land the cost could be still further reduced by applying the Paris Green in water, at the rate of one pound to eighty gallons. This method has the advantages of less cost, greater rapidity of application, more equable distribution and no danger of inhaling the poison. The Paris Green is insoluble in water and has to be kept thoroughly stirred if an even application is desired. This is easily accomplished with as little trouble as mixing the Paris Green with plaster. An ordinary sprinkler with a *fine vase* serves a good purpose in making the application.

SPRAYING TREES.

Spraying fruit trees with insecticides in solution, or suspension in water about the time the young fruit is forming, has become a common practice, and has been attended with good results. Paris Green, suspended in water, one pound to eighty gallons, applied thoroughly with a spraying pump with a spray nozzle, two gallons to the tree, has given good results. The ravages of the coddling moth, canker-worm, plum curculio and other insects are said to be materially checked by this treatment at a cost of ten cents per tree.

The station has tried "Lewis's Combination Hand Force-Pump" manufactured by Lewis & Cowles, Catskill, N. Y., and find it a

handy instrument well adapted to the uses of the farm and orchard. It is a brass pump and will readily throw water to the top of orchard trees from the ground or from a wagon. It can be used as a veterinary or agricultural syringe, or as a force pump. The instrument retails at six dollars. Every farmer or fruit grower ought to own some kind of a force pump.

REMEDY FOR ANTS.

Inquiries have been made for a way to exterminate field ants. Below we give the method advised, thinking it may be useful to some.

With a crowbar or some other instrument make three or four holes in different parts of the nest, extending to the bottom. By means of a tin tube, which any tinman can make, pour a few tablespoonfuls of kerosene oil to the bottom of each hole. Stop the holes with dirt and when convenient throw some dirt over the hill to keep the ants in. The kerosene oil will volatilize, permeate the chambers of the nest and kill the ants. When Bi-sulphide of Carbon can be obtained, perhaps it would serve a better purpose, being more volatile.

REMARKS.

The entomologist for the station desires to become acquainted with insects doing injury in the State to farm and garden crops, orchards and forest trees, also parasites upon domestic animals, or any insects in the State whether injurious, beneficial or neutral in their habits. Correspondence in regard to insects is cordially solicited and any one finding specimens not known is invited to send them here for determination. Below we give directions for sending specimens:

DIRECTIONS FOR SENDING SPECIMENS.

All inquiries about insects, injurious or otherwise, should be accompanied by specimens, the more the better. Such specimens if dead, should be packed in some soft material, as cotton or wool, and enclosed in a stout tin or wooden box. They will come by mail for one cent per ounce. INSECTS SHOULD NEVER BE ENCLOSED LOOSE IN THE LETTER. Whenever possible, larvæ (*i. e.* grubs, caterpillars, maggots, etc.) should be packed alive in a tight box—the tighter the better, as air-holes are not needed—along with a supply of their appropriate food sufficient to last them on their

journey; otherwise they generally die on the road and shrivel up. Send as full an account as possible of the habits of the insect respecting which you desire information; for example, what plant or plants it infests, whether it destroys the leaves, the buds, the twigs, or the stem; how long it has been known to you; what amount of damage it has done, etc. Such particulars are often not only of high scientific interest, but of great practical importance. In sending soft insects or larvæ that have been killed in alcohol, they should be packed in cotton saturated with alcohol. In sending pinned or mounted insects, always pin them securely in a box to be inclosed in a larger box, the space between the two boxes to be packed with some soft or elastic material, to prevent too violent jarring. PACKAGES SHOULD BE MARKED WITH THE NAME OF THE SENDER, and addressed to the entomologist for the Experiment Station, Orono, Me.

ANALYTICAL AND EXPERIMENTAL METHODS.

Protein Digestion.*

DIGESTIBILITY OF THE PROTEIN WITH ARTIFICIAL SOLUTIONS.

The methods employed in the artificial digestion experiments were essentially those finally proposed by Stützer, viz: the digestion of the finely ground substance for twenty-four hours in an acid pepsin solution at 40° C., followed by digestion with a solution of pancreas for the same time at the same temperature.

The variations in the methods were the use of scale pepsin instead of an extract from the inner membrane of a pig's stomach, the preparation of the pancreas solution in the way proposed by Dr. Chittenden, and in the case of the fodders from XXIX to 41 the digestion with pancreas for only twelve hours.

*Printed in advance nearly as given here in Agricultural Science November, 1888.

DIGESTIBILITY OF PROTEIN BY PEPSIN-PANCREAS DIGESTION.

			In water free substance.			Per cent total nitrogenous material digested.	Per cent. albuminoids digested.
			Total nitrogen per cent.	Albuminoid nitrogen, per cent.	Undigested by pepsin pancreas digestion.		
XXIV	Alsike clover	1886	1.81	–	.87	52.0	
XLI	"	1887	2.32	2.02	.457	80.3	77.4
XLII	White	1887	2.76	2.32	.502	81.8	78.4
XLIII	Blue joint	1887	1.61	1.42	.525	67.4	63.0
XXVII	Oat straw	1886	.63	–	.344	45.6	
XL	Orchard grass	1887	1.35	1.29	.393	70.9	69.6
L	Red Top	1887	1.55	–	.557	64.1	
XXIII	Timothy	1886	1.07	–	.464	56.5	
XLIV	"	1887	1.31	1.17	.338	74.2	71.1
LI	"	1887	1.25	–	.465	62.8	
XLV	Wild oat grass	1887	1.20	1.08	.414	65.5	61.7
XXXIX	Witch grass	1887	1.52	1.39	.325	78.7	76.6
XLVI	Buttercup	1887	1.62	1.53	.391	75.9	74.5
XLVII	White weed	1887	1.49	1.40	.398	73.3	71.5

A COMPARISON OF METHODS FOR THE DETERMINATION OF THE DIGESTIBILITY OF PROTEIN.

A reference to the coefficients of digestibility previously given shows that the coefficients of digestibility for protein differ in a marked manner as determined by the natural and artificial methods. The latter method gives coefficients from 3.7 to 51. per cent higher than the former, as is shown in a subsequent table, where the two sets of figures are placed side by side. In one instance only does the artificial digestion give a lower result. It is important to know the cause of these differences. On the one hand we have the long confessed inaccuracy of considering the nitrogen of the feces as

See page 148.

Number.	Name of Potatoes.	Date of planting.	Number of hills.	Date of blossoming.	Date of tops dying.	Date of digging.	Weight of large.	Weight of small.	Quality.
							lbs.	lbs.	
59	Monroe Co. Prize	May 15	120	July 4	Aug. 10	Sept. 26	127	6	Inferior.
60	Mitchless	"	46	" 8	" 16	"	26	37½	10⅔ Good.
61	Minister	"	108	June 25	" 13	"	26	136½	24 "
62	Mullally	"	52	July 10	" 13	"	26	73½	11½ Medium.
63	Manhattan	"	83		" 15	"	26	104	15 "
64		"	112	June 27	" 12	"	26	110½	20 Good.
65	New Wide Awake	"	120	July 1	" 1	"	26	114	15 Extra.
66	New Queen	"	111	June 27	" 12	"	26	131	10 "
67	Orange Co. White	"	120	July 4	" 19	"	26	146	21 Medium.
68	O. K. Mammoth Prolific	"	120		" 19	"	26	109	19 "
69	Old White Carter	"	120	" 2	" 19	"	27	68	19 "
70	Pearl of Savoy	"	120	June 25	" 20	"	27	96	20 Good.
71	Perfect Peach-blow	"	120	July 4	" 20	"	27	135	23 Inferior.
72	Purple Blush	"	86		" 16	"	27	74	20 Extra.
73	Putnam's Beauty	"	96	July 8	" 17	"	27	64	14½ Good.
74	Putnam's Early	"	120	June 27	" 12	"	30	122½	19 Medium.
75	Putnam's Select	May 16	86		" 12	"	30	77	23 Extra.
76	Putnam's New Rose	"	109	" 25	" 12	"	30	112½	14½ Good.
77	Pecan	"	78	" 25	" 15	"	30	62½	15 "
78	Perfect Gem	"	78		" 15	"	30	80	5½ "
79	Pride of Palestine	"	96	July 2	" 17	"	30	98	16 "
80	Queen of the Roses	"	120	June 22	" 13	"	30	74	11 Medium.
81	Queen of the Valley	"	120	" 27	" 16	"	30	77	10 Good.
82	Rose's Magnum Bonum	"	20	July 3	" 13	"	30	78	9½ "
83	Rural Blush	"	120	" 1	" 20	"	30	85½	12 "
84	Rochester Favorite	"	120	" 12	" 19	Oct 3		105½	9½ Medium.
85	Red Elephant	"	120	June 25	" 16	" 3		74	9½ "
86	Rose's New Giant	"	120	July 2	" 20	" 3		106	11 Inferior.
87	Rose's Beauty of Beauties	"	120		" 15	" 3		84	10½ Medium.
88	Rural New Yorker No. 2	"	120	" 4	" 17	" 3		46½	9 Inferior.
89	Randall's Beauty	"	84	" 4	" 16	" 3		70½	22½ Medium.
90	St. Patrick	"	12	" 3	" 19	" 3		73	12½ "
91	Stray Beauties	"	120		" 20	" 3		110½	15 Good.
92	Snow Queen	"	90		" 20	" 3		51	20 Extra.
93	Seneca Red Jacket	"	120	" 8	" 16	" 3		79	10½ Medium.
94	Thorburn	"	120	June 27	" 12	" 3		104	14½ Extra.
95	Thorburn Late Rose	"	120	" 27	" 13	" 3		86	12½ Good.
96	Triumph	"	120	July 4	" 12	" 3		87	12 Medium.
97	Thunderbolt	"	88		" 16	" 4		79	11 Inferior.
98	Vanguard	"	120	" 2	" 12	" 4		77	17½ Good.
99	Vermont Champion	"	126		" 15	" 4		109	17 Inferior.
100	Watson's Seedling	"	120	June 27	" 20	" 4		91½	18 Medium.
101	White Star	"	120	July 12	" 16	" 4		102½	15 Inferior.
102	White Elephant	"	120	" 4	" 19	" 4		108½	24 "
103	White Seedling	"	120	" 8	" 20	" 4		123½	6 "
104	Windoser's No. 1	"	100	" 2	" 12	" 4		89½	6½ Good.
105	Wood Ants	"	78		" 12	" 4		51	19 "
106	Wall's Orange	"	120	" 4	" 17	" 4		77	16½ Medium.
107	White Beauty of Hebron	"	120	June 27	" 15	" 4		113½	15½ Good.

Report of Botanist and Entomologist.*

PROF. F. L. HARVEY.

The work of the division of Botany and Entomology, the past season, has been in the directions indicated below:

BOTANY.

1. Germination Experiments.—To determine the vitality and purity of seeds sold in Maine.

2. Testing Varieties of Grasses.—To determine their adaptability to Maine.

3. Consideration of Potato Blight.—In an exigency bulletin and more in detail for this Report.

4. A Compilation (for this Report) of results of experiments on Apple Scab, made under the auspices of the Agricultural Department, Washington, D. C.

5. Examination of Fungi affecting Fruits, sent for determination by Fruit Growers.

6. Examination of Weeds, Grasses and other plants sent for determination.

7. Collection of herbarium specimens of grasses and other economic plants.

8. Collection of seeds of weeds and other plants, for use in naming seeds.

9. Paper—"Fungi Injurious to Fruits." Read before the State Pomological Society, and to appear in its Annual Report.

10. Consideration of False Flax and Rib Grass in this Report.

ENTOMOLOGY.

11. An Exigency Bulletin on the Apple Maggot.

12. The Apple Maggot.—An extended article for this Report.

13. Paper—"The Apple Maggot." Read before the Pomological Society at Norway, Me.

14. Preliminary study of a scale insect affecting the elms in Maine.

15. Preliminary study of the White Marked Tussock Moth and the Fall Web Worm.

16. Study of the Codling Moth to learn whether there are two broods in Maine.

*Issued from the [illegible] Experimental Station: Entomology.

MISCELLANEOUS.

17. Answering of many letters about insects, plants, fungicides, insecticides, spraying and spraying apparatus.

18. Article on spraying and spraying apparatus for this report.

That portion of the work mentioned above, which is completed and is of enough importance, is considered below. When comparing the work of this Station in Botany and Entomology with that of others, it should be remembered that the Botanist and Entomologist gives but one-third of his time to Station duties. Mr F. P. Briggs as Assistant, has rendered efficient service in conducting germination tests, looking after the grass plots, and collecting for the herbarium. Correspondence regarding plants and insects, especially injurious fungi and insects, is solicited. Directions for sending specimens may be found in Station Report, 1888, p. 194, or in Maine Agricultural Report, 1888, p. 158. I desire to thank the citizens of the State for the aid they have given me in the prosecution of my work, and also to thank the Director and other Station officers for their co-operation and encouragement.

GERMINATION EXPERIMENTS.

The germination experiments conducted the past season were a continuation of those performed and reported in 1888. They were conducted by Mr. F. P. Briggs in the same manner and with the same apparatus described in the Annual Report for 1888, p. 102. They were undertaken for two reasons: to test commission seeds, offered for sale in Maine, that were not examined in 1888; and to investigate a complaint from Aroostook County that dealers in that section were selling poor seeds.

For the first purpose we selected seeds put up by J. B. Rice, Cambridge, N. Y.; E. W. Lyman, Springfield, Mass.; A. H. Dunlap & Sons, Nashua, N. H.; and Lewis Atwood, Winterport, Me., and offered for sale on Commission in Orono, Me. The detailed results of these tests are shown in the general table, numbers 151 to 190 inclusive. Below is given a special table showing the seeds tested, the per cent. of each kind that germinated and the average.

COMPARATIVE RESULTS OF GARDEN SEEDS TESTED.

Seeds Tested.	Lettuce.	Cabbage.	Celery.	Parsnips.	Onion.	Turnip.	Tomato.	Radish.	Carrot.	Beet.	Average per cent. germinated.
Rice's, commission	46	90	68	58	81	74	84	88	45	81	71.5
Dunlap's, commission	98	74	10	52	36	79	78	76	56	92	65.1
Atwood's, commission	96	0	58	41	73	62	82	6	57	60	53.5
Lyman's, commission	0	9	1	32	0	0	4	57	80	22	18	33.4

The above table shows, that Rice's seeds were the best, that Dunlap's were second, Atwood's next and Lyman's much below the others and very poor. Rice's seeds were all good. Dunlap's seeds were all good excepting the celery. Leaving this out the others are nearly equal to Rice's. Atwood's cabbage and radish seed were the poorest tested and *very* poor. Leaving those out the others make a better showing, though inferior to either Rice's or Dunlap's. Lyman's cabbage seeds were the best tested and his radish seeds next best, but all the others were poor and none of the lettuce, parsnip and onion seed sprouted.

Among the seeds obtained from Aroostook County were some put up by the above dealers which has enabled us to farther test their quality. Lyman's seeds are not sold to any extent in Aroostook County. Those of Parker & Wood and Delano Moore, Presque Isle, Me., and Oscar Holloway, Auburn, Me., are sold. They are included in the table given below:

Seeds Tested.	Lettuce.	Cabbage.	Celery.	Parsnip.	Onion.	Turnip.	Tomato.	Radish.	Carrot.	Beet.	Salsify.	Sweet Corn.	Red Clover.	Timothy.	Alsike.	Pea-vine Clover.
Rice's, commission	83	85	23	58	84	72	99	83	46	77	66	85				
Dunlap's, commission	79	48		40	34	70		83	57	81						
Atwood's, commission	31	96		3		79	23	4		44						
Delano Moore's				82		99			82	84		90	81	93		
Oscar Holloway's													89	97	70	94
Parker & Wood's													77	95	76	

The above table confirms the statement regarding the relative quality of Rice's, Dunlap's and Atwood's seeds. The garden seeds of Delano Moore, grown in Aroostook County, showed a high germination per cent. and great vitality, but the timothy and clover seeds were a little inferior to others tested, though good. Those of Oscar Holloway and Parker & Wood did not include garden seeds, but their seeds of forage plants were of excellent quality.

For the purpose of easy comparison we reprint the table showing the result of work done in 1888.

Comparative Results of Garden Seeds Germinated.

Name.	Chick,s seed in bulk.		Dunning's seed in bulk.		Emerson's commission seeds in packets		Ferry's seeds in packets.		Iowa Seed Company's seeds in packets.		Dept Ag— seeds in packets.	
	Varieties tested.	Average per cent. germinated.	Varieties tested.	Average per cent. germinated.	Varieties tested.	Ave age per cent. germinated.	Varieties tested.	Average per cent. germinated.	Varieties tested.	Average per cent. germinated.	Varieties tested.	Average per cent. germinated.
Lettuce.....	1	99	1	77	1	10	1	98	-	-	2	90
Turnip.....	1	76	1	29	1	97	1	71				
Cabbage.....	1	69	1	88	1	92	1	73	-	-	4	80
Parsnip.....	1	44	1	34	1	49	1	70				
Celery.....	1	27	1	62	1	48						
Onion.....	1	74	1	62	1	95	1	67				
Beet.....	1	63	1	18	1	77	1	76	1	60		
Carrot.....	-	-	1	51	1	48	1	60			6	66
Tomato.....	-	-	-	-	-	-	-		-		4	58

To investigate the complaints from Aroostook County, seeds were purchased from John Watson, Houlton, Me; E. Merritt & Sons, Houlton, Me.; Chas. Wilson, Houlton, Me.; A. H. Fogg & Co., Houlton, Me.; J. A. Miller, Houlton, Me.; J. F. Hacker, Fort Fairfield, Me.

An examination of the general table Nos. 205 to 293 will show that the most of the seeds sold in Aroostook are Commission Seeds put up by various growers and dealers in and out of the State. The question then is largely what seeds sold in Aroostook are those of reliable growers, and what dealers handle them. The tables show that the garden seeds of Ferry, Rice and Moore have a high germinating power, that Dunlap's seeds are not

quite so good, that only about 50 per cent. of Atwood's seeds will sprout and that Lyman's seeds are very poor. The garden seeds from Delano, Moore were grown in Aroostook County and showing such vitality they give a promising outlook for Maine seed growers.

Remarks.

The most of the seeds offered for sale in Maine are not grown in the State, but are sold by growers outside of the State directly to the farmers, or are sold on commission by dealers in the State. Other seeds grown outside the State are purchased in bulk by wholesale Maine seedsmen and by them retailed loose, or in packets. Reliable seedsmen, in the autumn or winter, gather the seeds not sold by Commission Merchants and replace them by new. The seeds offered by some dealers would indicate that old seed is redistributed. It is to the interest of growers, wholesale dealers and packers to sell good seed, for a reputation can not be sustained with inferior seeds. It is to the interest of Commission Merchants to handle only reliable seeds. Failure of crops from poor seed is liable to create suspicion. The tests made by the Station confirm the judgment of growers, for those seeds found to be poor, are the ones the farmers suspect and the merchants will not recommend. We need no State law to regulate this matter as it will sooner or later regulate itself. Farmers by always selecting good seed will drive poor seed from the market.

The object of testing seeds at the Station is to point out reliable growers and those dealers in Maine who put up, or handle on commission, the seeds of reliable growers. We do not conduct these experiments to test the honesty of seedsmen, but in the interest of both planter and seedsmen, that the grower may know what seeds are reliable and that the dealer may know where to obtain them.

Our tests show that the seeds of some dealers, wherever taken in the State, have a high germinating power, while the seeds of others are *invariably* poor. Most Commission Merchants offer for sale the seeds of several growers, and it is the object of germination tests to show which growers puts up the best seeds. There is not care enough taken by many farmers in the selection of seed. Where no preference is expressed the Merchant is liable to dispose of the poorer seed. Farmers are sometimes in a hurry, and when the seed they usually plant cannot be readily had, they take almost

any kind. The selection of seed should be done before the rush of planting time, when care can be exercised. Our advice to farmers is to never buy seeds of doubtful character, and to dealers never to handle them. By working together, poor seed will be driven from the market, the business of reliable seedsmen become less precarious and the crops of the farmer more certain.

It should be remembered that the seeds tested were germinated under the most favorable conditions, and a larger number sprouted than would grow if planted in the ground. Two things may be learned from this: First, seeds which show a low vitality and germinating power with such favorable conditions would not germinate well in the ground. Second, seeds grown in a warmer climate may nearly all sprout in the germinator, but not come up well when put in the ground, or at least not produce a good crop, because they are not adapted to our climate. Good seeds grown in our latitude, if they could be obtained, would be the best to plant.

Moldy Seeds.

The apparatus used was scalded after each experiment, to destroy all germs of fungoid growth, but the seeds themselves, especially the poorer ones, contained spores which produced mold in two or three days. As seeds sprouted after being covered with mold for more than a week, it was supposed the surface mold did not affect their vitality. But to test the supposition, and also to see if anything could be found that would destroy the spores without injuring the seeds, a solution of corrosive sublimate in alcohol was tried. One part of the solution was diluted with ten thousand parts of water and the seeds dipped in this, then washed with water that had been boiled. In these cases the seeds did not mold nor did the solution injure them in any way as far as could be seen. About the same number sprouted as when the corrosive sublimate was not used. Only a few experiments were tried and these seemed to show, that the solution was neither benificial nor prejudicial to germination, though the mold might affect the growth after sprouting. More extended trials might show different results, and such may be undertaken another year.

Explanations.

In the following tables these abreviations for the growers of seeds are used: Rice, J. B. Rice, Cambridge, N. Y.; Lyman,

E. W. Lyman, Springfield, Mass.; Dunlap, A. H. Dunlap & Sons, Nashua, N. H.; Atwood, Lewis Atwood, Winterport, Me; Dept. Agr., Department Agriculture, Washington, D.C.; Moore, Delano Moore, Presque Isle, Me.; Holloway, Oscar Holloway, Auburn, Me.; P. & W., Parker & Wood; Ferry, D. M. Ferry & Co., Detroit, Mich. Numbers 151 to 190 inclusive were obtained in Orono, all of one dealer. Numbers 193 and 194 are two varieties of Cauliflower seed, sent to the station by H. A. Marsh, Fidalgo, Wash. He claims that the seed can be grown at half the cost of imported seed. It not only shows a great germinating power, but also high vitality, as nearly all the seeds sprouted in two days.

Numbers 205 to 216 were obtained from John Watson, Houlton, Me.; 217 to 246, of E. Merritt & Sons, Houlton, Me.; 247 to 256, of Charles Wilson, Houlton, Me.; 257 to 268, of A. H. Fogg & Co., Houlton, Me.; 269 to 293, of J. A. Miller, Houlton, Me.; 294 to 309, of J. F. Hacker, Fort Fairfield, Me.

RESULTS OF GERMINATION TESTS.

Serial number.	Station number.	DESCRIPTION.	Weight of 100 seeds in grams.	Number of seeds sprouted each day.													Sound seeds left.	Per cent. sprouted.	No. of days required for one-half to sprout.
				1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th			
		(Commission seeds purchased in Orono, Me.)																		
		LETTUCE.																		
151	165	Early Curled Silesia, Rice	.116	0	0	1	13	12	10	7	0	1	2	0	0	0	0	46		
152	166	" " " Lyman	.092	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
153	167	" " Simpson, Dunlap	.147	0	13	12	35	4	21	10	0	1	1	0	0	1	0	98	4	
154	168	Lee's Immense Hardy Green, Atwood	.140	0	51	34	6	3	1	1	0	0	0	0	0	0	0	96	2	
		CABBAGE.																		
155	169	Fottler's Improved Brunswick, Rice	.413	3	78	5	3	0	0	0	0	0	0	1	0	0	0	90	2	
156	170	Premium Flat Dutch, Lyman	.405	2	62	14	4	2	2	3	1	1	0	0	0	0	0	91	2	
157	171	Improved Low Flat Dutch, Dunlap	.339	2	54	14	0	3	1	0	0	0	0	0	0	0	0	74	2	
158	172	Early York, Atwood	.350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	0	
		CELERY.																		
159	173	Boston Market, Rice	.044	0	0	0	0	0	7	16	16	16	2	5	4	2	0	31	68	9
160	174	" " Lyman	.043	0	0	0	0	0	4	8	3	2	2	9	5	0	0	68	33	
161	175	" " Dunlap	.050	0	0	0	0	0	0	0	0	1	3	3	3	0	0	80	10	
162	176	" " Atwood	.051	0	0	0	0	0	2	6	18	10	13	4	3	2	0	34	58	11
		PARSNIP.																		
163	177	Long White Dutch, Rice	.371	0	0	0	0	4	15	11	15	7	4	1	0	1	0	40	58	9
164	178	" " " Lyman	.136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	
165	179	" " Smooth, Dunlap	.402	0	0	0	2	11	12	14	4	5	3	0	0	0	1	40	52	10
166	180	" Hollow Crown, Atwood	.392	0	0	0	0	0	10	17	4	3	6	1	0	0	0	28	41	
		ONION.																		
167	181	Yellow Danvers, Rice	.303	6	8	31	27	6	1	0	0	0	0	1	1	0	0	81	4	
168	182	" " Lyman	.338	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	0	
169	183	" " Dunlap	.347	6	6	11	14	4	1	0	0	0	0	0	0	0	0	40	36	
170	184	" " Atwood	.290	8	19	12	31	3	0	0	0	0	0	0	0	0	0	0	73	4

RESULTS OF GERMINATION TESTS.—(CONTINUED.)

Serial number.	Station number.	DESCRIPTION.	Weight of 100 seeds in grams.	Number of seeds sprouted each day.													Sound seeds left.	Per cent. sprouted.	No. of days required for one-half to sprout.
				1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th			
		TURNIP.																		
171	185	Skirving's Purple Top, Rice	.281	0	48	13	5	2	1	2	2	0	0	0	0	1	0	20	74	3
172	186	Carter's Improved, Lyman	.293	0	0	0	0	2	0	0	2	0	0	0	0	0	0	34	4	
173	187	Skirving's Purple Top, Dunlap	.278	1	63	7	2	2	1	0	1	1	0	0	1	0	0	17	79	2
174	188	Shamrock, Atwood	.306	0	31	11	5	4	3	2	2	0	0	3	0	1	0	31	62	6
		TOMATO.																		
175	189	Mikado, Rice	.249	0	3	14	61	5	1	0	0	0	0	0	0	0	0	0	84	4
176	190	Triumph Acme, Lyman	.258	0	1	0	14	36	3	2	0	1	0	0	0	0	0	29	57	5
177	191	Early Perfection, Dunlap	.265	0	0	0	56	16	3	2	0	0	1	0	0	0	0	9	78	4
178	192	Trophy, Atwood	.282	0	0	0	46	27	5	1	2	1	0	0	0	0	0	20	82	5
		RADISH.																		
179	193	Early Scarlet Turnip, Rice	.960	7	68	8	1	2	1	0	1	0	0	0	0	0	0	0	88	2
180	194	London Long Scarlet, Lyman	1.295	1	9	45	18	6	0	0	1	0	0	0	0	0	0	0	80	3
181	195	Early " " Dunlap	1.340	0	32	25	5	5	5	1	3	0	0	0	0	0	0	0	76	3
182	196	" Scarlet Turnip, Atwood	.900	0	0	0	0	4	1	1	0	0	0	0	0	0	0	0	6	
		CARROT.																		
183	197	Improved Long Orange, Rice	.100	0	0	0	29	10	5	1	0	0	0	0	0	0	0	35	45	
184	198	" " " Lyman	.132	0	0	0	5	11	5	1	0	0	0	0	0	0	0	54	22	
185	199	" " " Dunlap	.110	0	0	3	35	10	2	2	1	2	1	0	0	0	0	14	56	6
186	200	" " " Atwood	.106	0	0	3	36	12	4	1	1	0	0	0	0	0	0	21	57	5
		BEET.																		
187	201	Dening's Early Blood, Rice	1.585	0	0	1	30	28	15	2	2	0	0	0	0	2	1	13	81	5
188	202	" " " Lyman	1.481	0	0	0	17	19	6	2	2	1	0	1	0	0	0	30	48	6
189	203	" " " Dunlap	2.445	0	0	0	24	29	27	8	3	0	0	1	0	0	0	4	92	5
190	204	" " " Atwood	2.107	0	0	0	9	25	20	3	2	0	0	1	0	0	0	30	60	6
191	205	Salsify, Rice	1.230	0	0	35	16	1	1	7	3	1	0	0	0	2	0	18	66	4
192	206	" Lyman	1.026	0	0	0	0	1	0	3	1	2	0	0	0	0	0	1	7	

		Sent by H. A. Marsh, Fidalgo, Washington.																							
		CAULIFLOWER.																							
193	207	American Snowball, Marsh	.402	3	82	11	0	0	0	0	0	0	0	0	0	0	0	0	0	96	2				
194	208	Ertust Earliest Dwarf, Marsh	.348	1	95	2	1	0	0	0	0	0	0	0	0	0	0	0	0	99	2				
		Obtained from Dep't Agr'l, Washington, D. C.																							
		ONION.																							
195	209	Early White Nocera, Department Agriculture	.323	0	2	41	15	4	2	0	0	1	0	1	0	0	0	0	0	66	4				
196	210	New Aduatic Barletta, " "	.400	0	7	11	31	3	1	3	0	0	0	0	0	0	0	0	6	56	5				
197	211	Flat Maderia, " "	.384	0	0	66	12	8	0	1	0	0	0	2	0	0	0	0	4	89	5				
198	212	Giant White Italian Tripoli, " "	.324	0	18	34	16	9	2	0	0	0	0	1	0	0	0	0	12	80	3				
199	213	" Blood Red Racca, " "	.391	0	10	55	15	4	0	0	0	0	0	1	0	0	0	0	4	85	3				
200	214	Early White Queen, " "	.387	0	40	59	0	0	0	0	0	0	0	0	0	0	0	0	0	99	3				
201	215	Mammoth Silver King, " "	.375	0	25	68	4	0	0	0	0	0	0	0	0	0	0	0	0	97	3				
202	216	" Pompeii, " "	.376	4	57	10	2	1	1	0	1	1	1	0	0	0	0	0	0	78	3				
203	217	Giant Yellow Globe Racca, " "	.424	1	9	69	14	3	0	0	0	0	0	0	0	0	0	0	0	96	3				
204	218	White Maggiajola, " "	.312	0	22	51	15	1	0	0	1	0	0	0	0	0	0	0	0	90	3				
		Obtained of John Watson, Houlton, Me.																							
205	219	Hollow Crown Parsnip, Moore	.452	0	0	1	6	23	24	16	8	0	3	1	0	0	0	0	10	92	6				
206	220	Early Eclipse Beet, "	1.528	0	0	0	25	32	20	5	0	1	0	1	0	0	0	0	8	84	5				
207	221	" Cory Sweet Corn, "	29 582	0	0	0	13	45	21	8	1	2	0	0	0	0	0	0	0	90	5				
208	222	Ox-heart Carrot, "	.143	0	5	62	13	1	2	0	0	0	0	0	0	0	0	0	0	83	3				
209	223	American Ruta Baga Turnip, Moore	.293	90	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	99	1				
210	224	Danvers' Carrot, "	.102	40	30	10	0	1	0	0	0	0	0	0	0	0	0	0	0	81	2				
211	225	Red Clover, "	.175	35	35	9	2	0	0	0	0	0	0	0	0	0	0	0	0	81	2				
212	226	Timothy, "	.038	0	28	32	33	0	0	0	0	0	0	0	0	0	0	0	0	93	3				
213	227	Red Clover, Holloway	.145	51	20	18	0	0	0	0	0	0	0	0	0	0	0	0	0	89	3				
214	228	Timothy, "	.032	0	24	56	16	1	0	0	0	0	0	0	0	0	0	0	0	97	3				
215	229	Alsike Clover, "	.058	43	20	6	1	0	0	0	0	0	0	0	0	0	0	0	0	70	2				
216	230	Pea-vine Clover, "	.165	70	20	4	0	0	0	0	0	0	0	0	0	0	0	0	0	94	1				
		E. Merritt & Sons, Houlton, Me.																							
217	231	Sweet Fodder Corn, P. & W	19.000	0	0	3	36	25	5	1	0	0	1	1	0	0	0	0	0	72	5				
218	232	Sanford Field Corn, "	36.725	0	0	3	42	24	1	2	1	0	0	0	0	0	0	0	0	73	5	6			
219	233	Marblehead, " "	33.152	0	0	0	18	31	17	2	0	0	0	0	0	0	0	0	0	68	6	5			
220	234	Crosby's Early Sweet, Rice	21.130	0	0	1	35	29	8	1	2	0	0	0	0	0	0	0	0	76	5	3			
221	235	Red Clover, P. & W	.173	7	20	30	7	6	4	2	1	0	0	0	0	0	0	0	12	77	3	3			
222	236	Alsike " "	.056	49	2	13	0	2	1	0	0	0	0	0	0	0	0	0	0	76	3	3			
223	237	Timothy, "	.033	0	30	38	27	0	0	0	0	0	0	0	0	0	0	0	0	95	3	3	5		
224	238	Dewing's Blood Turnip Beet, Dunlap	2.21	0	0	0	19	35	16	3	6	0	0	1	1	0	0	0	0	81	5	6			
225	239	" " " " Ferry	2.30	0	0	0	10	23	37	11	3	1	1	0	0	0	0	0	0	86	5				
226	240	Long Smooth Parsnip, Dunlap	.388	0	0	0	1	8	9	12	7	2	2	1	0	0	1	0	0	43					
227	241	" Flat Dutch " Ferry	.92	0	0	0	1	5	10	16	7	8	2	3	2	1	0	0	0	54	11	6	2		
228	242	Early Prize Head Lettuce, Dunlap	.150	0	14	2	13	9	10	4	4	5	8	0	1	0	0	0	0	70					
229	243	White Head Lettuce, Ferry	.118	0	78	1	1	0	1	2	0	0	0	0	0	0	0	0	0	83					
230	244	Stone Mason Cabbage, Dunlap	.341	0	10	16	7	3	4	3	3	0	1	0	0	0	0	0	0	48					
231	245	Late Flat Dutch " Ferry	.330	1	29	61	1	1	2	0	0	0	0	0	0	0	0	0	0	95	3	6			
232	246	Long Orange Carrot, Dunlap	.095	0	8	15	23	2	6	3	0	0	0	0	0	0	0	0	0	57	3	6			

RESULTS OF GERMINATION TESTS.—(CONTINUED.)

Serial number.	Station number.	DESCRIPTION.	Weight of 100 seeds in grams.	Number of seeds sprouted each day.													Sound seeds left.	Per cent. sprouted.	No. of days required for one-half to sprout.
				1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th			
233	247	Long Orange Carrot, Ferry	.118	0	4	12	25	9	3	2	2	0	0	0	0	0	0	15	70	5
234	248	Purple Top Turnip, Dunlap	.00	3	10	21	14	3	4	2	0	0	0	0	0	0	0	0	97	5
235	249	" " " Ferry	.280	0	10	32	11	4	5	3	0	0	0	0	0	0	0	0	85	4
236	250	Phinney's Early Watermelon, Dunlap	3.600	0	0	0	0	0	3	38	10	1	0	0	0	0	0	0	52	6
237	251	Mountain Sprout, " Ferry	4.512	0	0	0	6	20	56	0	4	0	0	0	0	0	0	0	10	82	6
238	252	Early Red Globe Onion, Dunlap	.368	4	16	10	2	0	0	0	0	0	0	0	0	0	0	0	15	68	6
239	253	" Long Scarlet Radish. Ferry	1.412	1	54	6	3	3	1	0	0	0	0	0	0	0	0	0	0	68	3
240	254	Five varieties Radish, Rice	.978	7	68	6	1	1	0	0	0	0	2	0	2	0	0	0	0	86	3
241	255	Livingston's Perfection Tomato, Ferry	.292	0	0	4	36	0	4	4	0	0	0	0	0	0	0	0	0	48	5
242	256	New Dwarf Champion " Rice	.298	0	0	30	61	4	3	1	0	0	0	0	0	0	0	0	0	99	4
243	257	Tupple Curled Parsley, Ferry	.175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
244	258	Burple's Ruby King Pepper, Rice	.675	.	0	0	0	0	2	4	10	8	2	1	1	0	0	0	0	28	
245	259	Gregory's Early Mammoth Cabbage, Rice	.3	50	25	8	2	0	0	0	0	0	0	0	0	0	0	0	0	85	1
246	260	White Plume Celery, Rice	.040	0	0	0	0	2	10	7	3	1	0	0	0	0	0	0	0	23	
		Purchased of Chas. Wilson, Houlton, Me.																			
247	261	Long Dark Blood Beet, Atwood	1 834	0	0	2	18	12	7	3	2	0	0	0	0	0	0	0	52	44	
248	262	Mountain Sweet Watermelon, Atwood	10.510	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	94	3	
249	263	Student Parsnip, "	.410	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	94	3	3
250	264	Golden Ball Turnip, "	.198	0	20	32	17	7	6	3	0	1	0	0	0	0	0	0	0	85	3
251	265	Skirving's Purple Top Turnip, "	.275	13	20	14	6	2	8	4	1	1	2	1	0	0	0	0	0	72	3
252	266	Early Scarlet Radish, "	.900	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	4	
253	267	English Broad Leaved Sage, "	.724	0	0	0	0	0	0	1	2	2	0	1	0	0	0	0	0	6	
254	268	Flat Dutch Cabbage, "	.285	1	74	13	3	2	1	2	0	0	0	0	0	0	0	0	90	6	
255	269	Smooth Red Tomato, "	.330	0	0	0	0	1	3	4	3	5	5	2	0	0	0	0	0	96	2

256	270	Curled Silesia Lettuce	.150	0	10	3	1	13	1	0	0	0	2	0	0	0	0	26	30						
		Purchased of A. H. Fogg & Co., Houlton, Me.																							
257	271	Blood Turnip Beet, Rice	1.559	0	0	0	17	24	20	5	1	2	1	1	0	0	0	22	71	6					
258	272	Long White Dutch Parsnip, Rice	.417	0	0	0		0	3	13	18	11	5	5	2	1	0	42	58	10					
259	273	Simpson Lettuce, "	.164	0	63	3	10	4	2	1	0	0	0	0	0	0	0	14	83	2					
260	274	Evergreen Sweet Corn, "	22.176	0	0	3	22	30	29	7	2	1	0	0	0	0	0	0	94	5					
261	275	Wethersfield Red Onion, "	.341	10	32	39	7	4	1	0	1	0	0	0	0	0	0	3	94	3					
262	276	Flat Dutch Turnip, "	.210	12	15	22	14	3	4	2	0	0	0	0	0	0	0	10	72	4					
263	277	Early Scarlet Radish, "	.880	5	70	4	3	0	0	0	0	0	0	0	0	0	0	0	82	2					
264	278	Henderson's Early Cabbage, "	.413	56	24	12	1	1	0	0	0	0	0	0	0	0	0	0	94	1					
265	279	Short Horn Carrot, "	.125	0	0	10	23	6	5	2	0	0	0	0	0	0	0	20	66						
266	280	White Clover,	.074	51	26	4	1	1	0	0	0	0	0	0	0	0	0	0	83	1					
267	281	Alsike "	.062	36	12	10	4	3	1	0	0	0	0	0	0	0	0	30	66	4					
268	282	Red "	.145	45	30	14	0	0	0	0	0	0	0	0	0	0	0	0	89	2					
		Purchased of J. A. Miller, Houlton, Me.																							
269	283	Stowell's Evergreen Sweet Corn, Ferry	22.576	0	0	1	28	40	28	2	0	0	0	0	0	0	0	0	99	5					
270	284	New Cory Sweet Corn, Rice	21.428	0	0	0	5	38	21	14	5	3	1	0	0	0	0	0	87	6					
271	285	Dark Red Eclipse Beet, "	2.237	0	0	12	50	11	10	1	0	0	0	0	0	0	0	16	74	4					
272	286	Mammoth Cabbage Lettuce, Rice	.173	0	81	5	4	1	0	0	0	0	0	0	0	0	0	0	91	2					
273	287	New Volunteer Tomato, "	.347	0	11	65	13	2	0	0	0	0	0	0	0	0	0	0	91	3					
274	288	Burpee's Ruby King Pepper, "	.666	0	0	0	0	0	1	8	5	5	2	1	2	1	0	75	25						
275	289	Blood Turnip Beet, Dunlap	1.450	0	0	0	20	24	15	8	3	0	2	0	1	0	0	15	73	6					
276	290	Silver Leaf Beet, "	1.770	0	0	0	23	36	11	8	1	2	0	1	0	0	0	14	82	5					
277	291	Winingstadt Cabbage, "	.312	0	0	4	2	2	2	5	3	2	2	2	1	0	0	75	25						
278	292	Purple Top Turnip, "	.04	80	2	2	3	2	1	0	0	0	0	0	0	0	0	0	90	1	2				
279	293	Early Scarlet Radish, "	1.421	0	68	8	1	3	2	1	0	0	0	0	0	0	0	0	95	2					
280	294	" Red Globe Onion, Dunlap	.323	3	17	15	1	0	0	0	0	0	0	0	0	0	0	12	48						
281	295	" Prize Head Lettuce, "	.168	0	9	7	22	27	5	2	0	6	4	0	0	0	0	0	82	5					
282	296	White Smooth Parsnip, "	.418	0	0	0	6	4	8	9	7	5	3	1	0	0	0	13	57						
283	297	Blood Turnip Beet, Ferry	2.120	0	0	1	6	30	33	7	9	0	0	1	2	0	0	11	89	6					
284	298	Long Orange Carrot, "	.122	0	0	15	14	8	2	2	3	0	0	0	2	1	0	10	47						
285	299	Yellow Montanagny Turnip, Ferry	.302	7	28	30	30	3	1	0	0	0	0	0	0	0	0	0	99	3					
286	300	Strap Leaved Turnip, "	.08	73	10	4	1	1	0	0	0	0	0	0	0	0	0	0	89	1	2				
287	301	Winingstadt Cabbage, "	.310	4	79	5	1	0	1	0	1	1	1	0	0	0	0	0	93	2					
288	302	Crawford's Half Dwarf Celery, Ferry	.058	0	0	0	0	2	3	7	3	4	2	1	1	0	0	4	24						
289	303	Early Scarlet Radish, "	1.43	34	33	3	1	0	0	0	0	0	0	0	0	0	0	0	71						
290	304	Peerless Watermelon, "	9.623	0	0	0	0	20	30	10	4	0	2	0	0	0	0	34	66						
291	305	Long White Dutch Parsnip, "	12	0	0	0	0	2	14	15	6	3	1	2	0	0	0	0	43						
292	306	Sweet Mountain Pepper, "	.660	0	0	8	20	5	5	3	5	5	2	3	1	0	0	0	57	8	2				
293	307	Trophy Tomato, "	.314	0	54	29	3	1	1	0	2	0	0	0	0	0	0	0	90	2					
		Purchased of J. F. Hacker, Fort Fairfield, Me.																							
294	308	Alsike Clover	.064	13	30	9	2	0	0	0	0	0	0	0	0	0	0	0	54	2					
295	309	Red Clover	147	20	20	15	5	1	1	0	0	0	1	0	0	0	0	0	63	2	3				
296	310	Timothy	.041	2	14	20	38	3	3	2	0	0	0	0	0	0	0	0	81	1					
297	311	"	.041	0	9	30	44	6	2	0	0	0	0	0	0	0	0	0	91	1					
298	312	Red Clover	150	0	4	9	9	4	2	1	0	0	0	0	0	0	0	0	29						

RESULTS OF GERMINATION TESTS.—(CONTINUED.)

Serial number.	Station number.	DESCRIPTION.	Weight of 100 seeds in grams.	Number of seeds sprouted each day.													Sound seeds left.	Per cent. sprouted.	No. of days required for one-half to sprout.
				1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th			
299	313	Timothy	.040	0	20	36	35	0	1	0	0	0	0	0	0	0	0	0	92	3
300	314	Ruta Baga Turnip, Ferry	.305	16	65	5	3	3	1	0	0	0	0	0	0	0	0	6	93	2
301	315	Purple Top " "	.302	0	28	17	5	2	3	4	2	1	0	0	1	0	0	12	53	4
302	316	Jersey Wakefield Cabbage, Ferry	.313	52	33	0	0	0	0	0	0	0	0	0	0	0	0	15	85	1
303	317	Winingstadt " "	.309	6	52	8	2	0	0	0	0	0	0	1	0	0	0	0	69	2
304	318	Blood Turnip Beet, "	2.213	0	0	28	43	15	2	1	0	0	0	1	0	0	0	0	90	4
305	319	Dark Red Eclipse Beet, Rice	2.014	0	1	25	17	6	2	0	1	0	0	0	1	0	0	0	53	6
306	320	Drumhead Cabbage, "	.321	4	41	1	0	0	0	0	0	0	0	0	1	0	0	0	47	
307	321	Blood Turnip Beet, Dunlap	2.441	0	0	32	27	4	1	1	1	1	2	0	0	0	0	0	33	4
308	322	Red Globe Onion, "	.298	0	19	9	1	1	1	2	0	0	0	0	0	0	0	0	33	
309	323	White Smooth Parsnip, Dunlap	.402	0	0	0	8	21	9	8	1	2	3	0	0	0	0	0	47	

EXPERIMENTS WITH FORAGE PLANTS.

In the spring of 1888, about seventy varieties of grasses and other forage plants were sown in plots. Some of these failed to grow; others grew the first season and winter killed, while a number proved to be duplicates. Those that grew more or less satisfactorily are below considered. Those that seem promising will be further tested in larger plots under the most favorable conditions of soil and moisture and the yield per acre recorded.

GRASSES.

1.	Brown Bent,	*Agrostis canina*
2.	Red Top,	" *vulgaris*
3.	Creeping Bent,	" *stolonifera*
4.	Meadow Fescue,	*Festuca pratensis*
5.	Tall "	" *elatior*
6.	Sheep "	" *ovina*
7.	Hard "	" *duruscula*
8.	Wood Meadow,	*Poa nemoralis*
9.	Kentucky Blue,	" *pratensis*
10.	Rough-stalked Meadow,	" *trivialis*
11.	English Blue,	" *compressa*
12.	Fowl Meadow,	" *serotina*
13.	Rescue Grass,	*Bromus unioloides*
14.	Meadow Brome,	" *pratensis*
15.	Soft Chess,	" *mollis*
16.	Slender Foxtail,	*Alopecuris agrostis*
17.	Rye Grass,	*Lolium perenne*
18.	Tall Oat-grass,	*Arrhenatherum avenaceum*
19.	Sweet Vernal,	*Anthoxanthum odoratum*
20.	Timothy,	*Phleum pratense*
21.	Velvet Grass,	*Holcus lanatus*
22.	Orchard "	*Dactylis glomerata*
23.	Reed Canary,	*Phalaris arundinacea*
24.	Crested Dogstail,	*Cynosurus cristatus*

CLOVER.

25.	Alsike,	*Trifolium hybridum*
26.	Red,	" *pratense*
27.	White,	" *repens*
28.	Crimson,	" *incarnatum*

MISCELLANEOUS.

29.	Sweet Clover,	*Melilotus alba*
30.	Honey, "	" *caeruleus*
31.	Alfalfa,	*Medicago sativa*
32.	Black Medic,	" *lupulina*
33.	Sainfoin,	*Onobrychis sativa*
34.	Small Pea,	*Lathyrus sativus*
35.	Hairy Vetch,	*Vicia villosa*
36.	Birds-foot Clover,	*Lotus corniculatus*
37.	Serradella,	*Ornithopus sativus*
38.	Tarweed,	*Madia sativa*
39.	Giant Spurry,	*Spergula maxima*

Notes on Grasses and Forage Plants.

1. Brown Bent Grass.—This grass is sometimes called Mountain Red Top, on account of its growing naturally on hills and mountains, and is reported as being a slender grass 6 to 12 inches high. In the plot it grew about 18 inches, which was of course due to the greater fertility of the soil. It could not produce a large crop of hay even on very rich ground, but is valuable as a pasture grass. It came into full bloom June 28.

2. Red Top.—This is probably the most valuable of the Bent grasses. It made a good growth although the soil must have been rather dry for it, as it prefers moist land. It has a strong, erect stem, and is a good grass to sow on swampy ground with Fowl Meadow, to prevent the latter from lodging. It attained a height of nearly three feet, and sown with clover or other grasses would give a good crop of hay. It blossomed July 1, a little later than the other Bent grasses.

3. Creeping Bent.—A grass described as growing to the height of 24 inches on wet land. Ours was only 14 inches high, owing to dry soil, and was a fine grass, with thick bottom. It blossomed June 28. It would be useless to sow on up-lands, but is said to produce a good crop on swampy meadows.

4. Meadow Fescue.—This is a valuable grass for either hay or pasture. It is one of the earliest to start in the spring, and comes to maturity in good season, June 21 being the date of full bloom. Unlike most grasses the stalks and leaves remain green till it ripens its seed. It grows on either dry or wet soil, gravel,

loam, or clay, and its long roots enable it to withstand droughts. To obtain the seed pure is a difficult matter, as it is often adulterated with Rye grass, hence one needs to exercise care in purchasing. It grew 3 feet high. This grass deserves a trial in Maine.

5. Tall Fescue.—Very much resembles the grass just mentioned, being a little larger. It has the same habits of adapting itself to any kind of soil. A chemical analysis shows it to be very nutritious. It has a tendency to grow in tufts like most of the Fescue grasses. Produces a large crop of hay on rich ground, sometimes growing 4 or 5 feet high, but in our plot measured three feet. Blossomed June 28.

6. Sheep Fescue.—Said to be an excellent pasture grass, especially for sheep. It grows in bunches, having a large mass of small nearly cylindrical leaves from the root, and a few slender stems, of which the highest measured 16 inches. When sown thickly it forms a very dense bottom, which furnishes a good bite for stock, but is too fine for hay. Came into full bloom June 12.

7. Hard Fescue.—Resembles Sheep's Fescue, being a little larger, and like it, grows on dry hills. What was said of that, will also apply to this species. It grew 18 inches high, and blossomed June 13.

8. Wood Meadow Grass.—This grass grows in moist shady places, two feet or more in height. In the plot it was about 18 inches high, and rather slender. It blossomed June 28. Not much of the seed sprouted, consequently the plants were scattered, and as the ground was hardly suitable for it, one could not tell what it would do under favorable conditions. It has not been cultivated much, probably on account of its growing best in the shade.

9. Kentucky Blue Grass.—A great deal has been written concerning Kentucky Blue Grass, some claiming it to be the most valuable, others saying it is one of the most worthless of the tame grasses. It is certainly a nutritious grass, especially before blossoming, but deteriorates rapidly as it grows older. It is one of the first to blossom, June 12 being the date of full bloom, hence needs to be cut early, and therefore cannot be sown with many other grasses. Our tallest plants measured 21 inches, but it is often higher than this. It has an abundance of long leaves from the root.

10. Rough-Stalked Meadow Grass.—As its name implies this is a grass growing in wet meadows, having a rough stem, by which it may be distinguished from most of its genus. It blossomed June 28, and measured 27 inches, which is below its natural height. It is recommended for shady pastures.

11. English Blue Grass.—A grass found growing on dry, sandy or gravelly knolls, and hence of some value for dry pastures. It is sometimes called Wire grass as it has a tough, hard stem which is difficult to cut. The spike has a purplish or bluish tinge, and the leaves are a bluish-green, so that it well deserves the name of Blue grass. It grew larger than it is usually found in its wild state, being 20 inches high. Blossomed June 30.

12. Fowl Meadow Grass.—This species is well known to farmers who have swampy meadows. It produces a heavy crop of hay, often three tons or more to the acre. Unlike most grasses it keeps green long after blossoming. It has a tendency to lodge badly, but instead of decaying it sends up shoots from the joints, which keep the stalks green. It should be harvested before lodging, however, as it is then much easier to cut. This grass generally gives way in time to the coarser water grasses and sedges, and needs to be resown. It is perhaps the most valuable of our wet meadow grasses. It grew in dry soil 30 inches high, and blossomed June 30.

13, 14, 15. Brome Grasses.—The seeds of all these grasses were poor and but few plants were obtained. The cheat or chess, often found growing as a weed in grain fields, belongs to this genus. The only one that has any claim as a cultivated grass is the Rescue grass, which is grown for winter pasturage in the south. It would be of no value here. The farmer should treat them as weeds, and prevent them from getting a foot-hold in his fields, if possible.

16. Slender Foxtail.—The Foxtail grasses bear some resemblance to Timothy, having, like it, a cylindrical spike. They grow naturally in moist bottom lands. This species has purplish heads and the stalks near the ground are of the same color. It blossomed early, June 13, and made a good growth for dry soil, 22 inches. It is not generally recommended but we consider it worth a trial.

17. Rye Grass.—A perennial grass cultivated for many years in Europe, and considered one of their best grasses, but in this

country has not met with so much favor. It has numerous leaves from the root, and an erect, dry, wiry stem 20 inches high, with a long undulating spike, somewhat resembling our common Witch grass (*Agropyrum repens.*) It blossomed July 3.

18. Tall Oat Grass.—This grass is said to often attain a height of 6 feet; in our plots it was a little over three. It bears a resemblance to our common oat, though is smaller in every way except in height. It will produce two crops in a season, and many declare it to be an excellent grass, while others say it is bitter, liable to smut, and difficult to eradicate. It needs to be tested farther before it can be recommended. Blossomed June 21.

19. Sweet Vernal Grass.—A common grass in old fields and pastures, and one of the earliest to blossom, June 13 being the date of our plot. It is fragrant when drying and gives a pleasant odor to new mown hay. It is too small for a hay crop, being less than two feet high. Our plants were only a foot high, owing to the seed being sown too thickly.

20. Timothy.—Also called Herd's grass, and too well known to need any description. Is generally considered one of our best grasses, although a chemical analysis shows that there are many others more nutritious. The height varies greatly according to the fertility of the soil. Our plants were 3 feet. It blossomed June 21. It should be cut early as it grows woody rapidly after blossoming.

21. Velvet Grass.—A pretty grass with an abundance of velvety leaves from the root, and a soft purplish spike. Grows best on moist land, but will adapt itself to any soil. Said to be of no value as an agricultural grass as cattle do not relish it. Blossomed June 21, and grew 18 inches high.

22. Orchard Grass.—A tall grass growing in bunches, and furnishing a large crop of hay when sown thickly or with other grasses. It starts quickly after mowing and produces a good aftermath. It blossomed June 13, about the same time as Red Clover, and these two sown together will give two crops of excellent hay in a season. It grew 4 feet high. It deserves to be grown more in this State.

23. Reed Canary Grass.—This is a tall, coarse grass found in wet places; not much value as hay unless cut very early. It may be mown two or three times in a season, as it is a rapid grower. One plot produced a growth of leafy stems about 2 feet

high, but did not blossom although allowed to grow till late in the season, the soil evidently being too dry. It grows 4 feet or more high, in swampy ground.

24. Crested Dogstail.— A dry, wiry, light colored grass with slender stem and small spike. Not much value except in dry pastures. Grew in plot 22 inches high. Blossomed July 3. The straw is used for braiding.

25, 26, 27. Alsike, Red and White Clover.—These are well known and considerably cultivated all over the State. The first two make excellent hay, and the last furnishes good pasturage. The height, and time of blossoming is given to compare with the grasses. All in full bloom June 10. The heights were 24, 30, and 12 inches, respectively.

28. Crimson Clover.—Also called Scarlet, French, Italian, and Incarnate clover. Unlike the three above, it is an annual, and therefore cannot be used for seeding down. For this reason it is not cultivated very extensively in the North. It has more elongated heads than the Red clover, which are a bright crimson. It was sown June 1, and blossomed Sept. 1, following. Height 26 inches.

29. Sweet Clover.—Not a true clover, but closely connected. A tall, busy plant often found growing wild. Perhaps of some value as a fodder if cut when small. Blossomed July 3; tallest plants, 8 feet.

30. Honey Clover.—An annual, growing 18 inches high, and having numerous heads of blue flowers, which furnish considerable honey to bees; of more value for this purpose than for a fodder.

31. Alfalfa or Lucerne.—A deep rooted, erect plant, 2 to 3 feet high, growing best in a dry, sandy soil. It has a branching, leafy stem bearing a dense raceme of blue flowers. It must be cut while young, as it soon becomes woody. A number of crops can be obtained the same season, and it is said to produce an immense amount of rich fodder year after year. It stands drought well on account of its long roots which it sends into the ground 12 or 15 feet deep. Two or three years are required for it to become well established, which perhaps accounts for its not being cultivated more extensively in the North. It deserves a thorough trial in Maine.

32. Black Medic.—The seed of this was obtained under the name of Yellow Trefoil. It is a small, half trailing plant with

heads of yellow flowers. It is not large enough to produce much fodder, and would hardly be worth cultivating. Blossomed June 25; over one foot high.

33. Sainfoin.—This plant is said to grow well on poor, run out land, and in Europe is used for soiling to considerable extent. It is a straggling plant from a hard, woody tap root, having pinnate leaves and a spike of handsome purple flowers. Under favorable conditions grows 3 feet high, but in our plot only 15 inches. Blossomed June 13.

34. Small Pea.—The seed of this, and of the next three plants was received from the Department of Agriculture, and we give the description accompanying the seed:

"Extensively cultivated in Southern Europe, for its seed, which is eaten in the same way as the Chick Pea, but it is of superior quality; the pod is also eaten green and the whole plant is sometimes cut for forage, while the peas are much given to poultry."

It resembles the common pea, being smaller: 20 inches high. Planted June 1, blossomed Aug. 20.

35. Harvy Vetch.—"A native of Persia and the borders of the Caspian Sea, but is cultivated extensively in almost every quarter of the globe. Its roots are diuretic, while its seeds, in spite of their nutritious qualities, are not wholly destitute of poisonous ingredients."

Very much resembles our common vetch, (*Vicia Cracca.*) Grew about 2 feet high. Blossomed Aug. 30. Planted same time as one preceding.

36. Birds-foot Clover.—"Is found in the greater part of Europe, in Northern Africa, Northern Central Asia, and in Australia. The larger varieties form a very good ingredient in our pastures and meadows."

Our plants were 14 inches high. They had a tap root, sending up numerous branches with bright yellow flowers. Blossomed June 25.

37. Serradella.—"A native of Portugal, is a valuable agricultural plant, introduced in 1818, and particularly worthy of attention from the fact of its producing an abundant crop of excellent fodder where nothing else will grow to perfection. It is an annual."

This is a branching, leafy plant, having small, purplish flowers. We only obtained a few specimens, and these were scarcely a foot high. Planted June 1, and blossomed Aug. 27.

38. Tarweed.—This belongs to the Composite family, the same as our common dandelion and white weed. It is a stout, erect plant, 3 feet high, with numerous lanceolate leaves, and yellow flowers. The stem is covered with glandular hairs which exude a viscid substance making it exceeding sticky, from which it has received the name of Tarweed. When green it has a strong, heavy odor due to some volatile liquid which is dissipated in drying. It is an annual, and seeds itself if allowed to mature. Blossomed Aug. 27.

39. Giant Spurry.—The following accompanied the seed:

"Grown to serve as pasture for cattle, imparting a fine flavour to mutton, and enriching the milk of cows. Its foliage is of a pleasant green color and delicate texture; it soon establishes itself, and possesses the recommendation of retaining its verdure in the dryest and hottest season."

This is very much like the common spurry, (*Spergula arvensis*,) which is a weed in crops, and seems to have the same habits. It continues to blossom and ripen its seeds all the season, thus producing an enormous quantity, which sprout and grow very readily. It doubtless has some good qualities, but once introduced it would be difficult to get rid of, and should therefore be treated as a weed. Blossomed July 25, two months from sowing. Height 15 inches.

Remarks.

The hay crop in this State is our most valuable one. It can easily be increased in quantity, and improved in quality. Some of the best grasses and forage plants are scarcely cultivated in Maine, and it is the purpose of the Station to test their adaptability to our soil and climate, and call the attention of farmers to those that seem worthy of cultivation. We quote from two writers as follows: "The importance of introducing new grasses, and efforts to improve those already cultivated, cannot be overestimated. It is not at all certain that we have the best kinds, nor that those we have are brought to the greatest degree of perfection. Doubtless they may be improved, as well as fruits and live stock."

"A dozen sorts, probably, cover nineteen-twentieths of all the meadow land from Maine to Texas. It can hardly be supposed that so limited a number meets, in the best manner possible, all

the wants of so great a variety of soil and climate. This is one of the pressing wants of our agriculture. A single new grass that would add but an extra yield of a hundred lbs. to the acre, would add millions of dollars annually to the productive wealth of the nation."

When we remember that there are over three thousand different grasses, and a great many other plants valuable for hay and grazing, we can easily see the chances for improvment in this direction. Our experiments have not been carried on long enough to enable us to recommend with certainty, many new grasses. We would suggest the following for the purpose named:

HAY ON UPLANDS.

Timothy,	*Phleum pratense*
Red Top,	*Agrostis vulgaris*
Tall Fescue,	*Festuca elatior*
Meadow Fescue,	" *pratensis*
Orchard Grass,	*Dactylis glomerata*
Alsike Clover,	*Trifolium hybridum*
Red Clover,	" *pratense*
Alfalfa,	*Medicago sativa*

HAY ON WET MEADOWS.

Fowl Meadow,	*Poa serotina*
Red Top,	*Agrostis vulgaris*
Creeping Bent,	" *stolonifera*
Tall Fescue,	*Festuca elatior*

DRY PASTURES.

Brown Bent,	*Agrostis canina*
Sheep Fescue,	*Festuca ovina*
Hard Fescue,	*Festuca dunuscula*
Blue Grass,	*Poa compressa*
White Clover,	*Trifolium repens*

MOIST OR SHADY PASTURES.

Creeping Bent,	*Agrostis stolonifera*
Rough-stalked Meadow,	*Poa trivialis*
Meadow Fescue,	*Festuca pratensis*

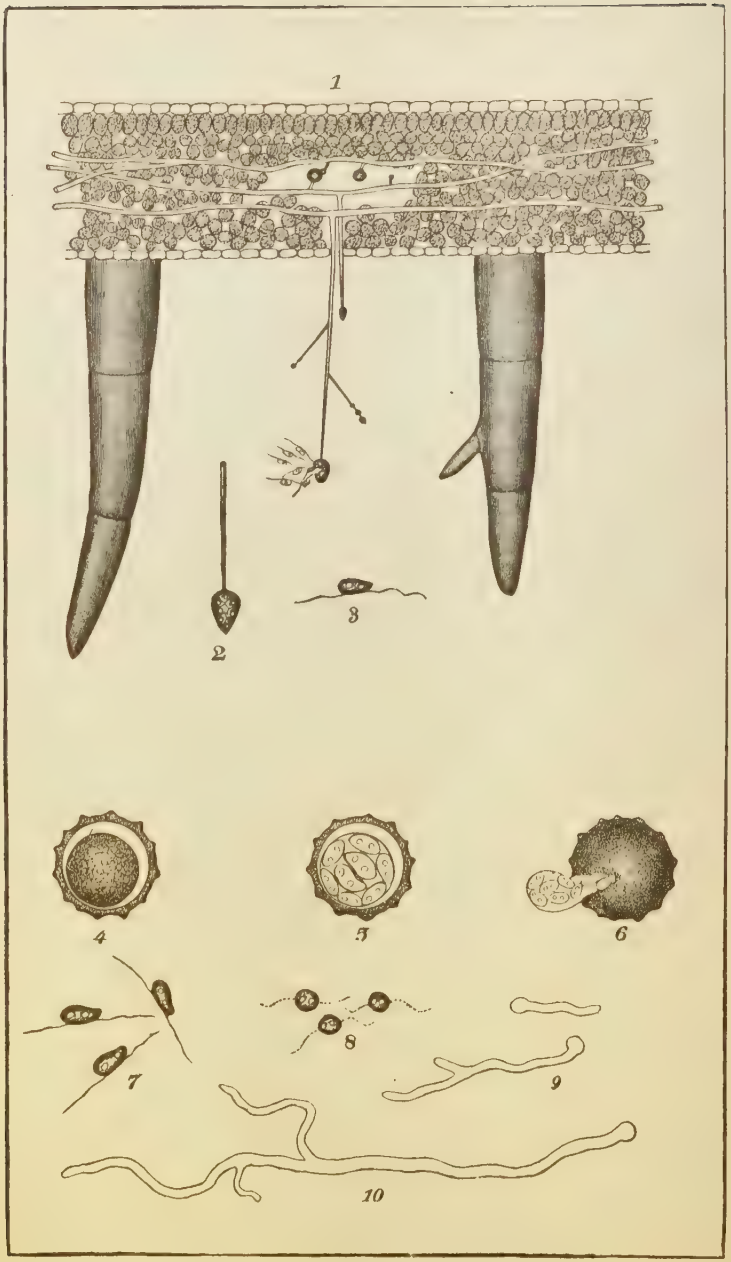
INJURIOUS PLANTS.

Plants of Economic Importance Received for Examination in 1889.

	COMMON NAME.	SCIENTIFIC NAME.	DEPREDATIONS.
		PARASITIC FUNGI.	
1	Potato Rot, Rust, Blight	*Phytophthora infestans*	On potato vines and tubers.
2	Apple Scab, or Black Spot	*Fusicladium dendriticum*	On apple stems, leaves and fruit.
3	Bitter Rot	*Gloeosporum versicolor*	On apples.
4	Scarlet Rot		On apples.
5	Pear Blight	*Micrococcus amylovorus, Bur*	On pear twigs and leaves.
6	Downy Mildew, Gray Rot	*Peronospora viticola*	On grape leaves and fruit.
7	Powdery Mildew	*Uncinula ampelopsidis, Pk*	On grape leaves.
		WEEDS.	
8	Pigweed, or Green Amarantus	*Amarantus retroflexus, L*	Weed in garden.
9	False Flax, or Gold of Pleasure	*Camelina Sativa, Crantz*	" " fields.
10	Black Bindweed	*Polygonum convolulus, L*	" " garden and fields.
11	Rib Grass, English Plantain	*Plantago lanceolata, L*	" " fields.
12	Downy Vetch	*Vicia Cracca, L*	" " "
13	Wild Pink	*Silene Pennsylvanica*	" " garden.
14	Fall Dandelion	*Leontodon autumnale, L*	" " meadows.

Remarks.

Besides the plants mentioned above quite a number of specimens of no special economic importance have been examined and reports made directly to the parties sending them. The Potato Rot was considered in an exigency bulletin in the summer of 1889. The subject is of so much importance, that article modified and extended, is incorporated in this Report. The Apple Scab was very bad in Maine the past season. We considered this fungus in our Report for 1888, but now add (through the kindness of Prof. Galloway) the results of some experiments conducted the past season under the auspices of the U. S. Agricultural Department. We are arranging to conduct some experiments this season upon Apple Scab with the copper solutions. A paper presented by the writer at the Norway Meeting of the State Pomological Society, upon "Some Injurious Fungi of Fruits," will appear in the Report of that Society. It will in that way reach the fruit growers of the State and need not be repeated here. Of the weeds sent for examination the Rib Grass, or English Plantain, and False Flax, or Gold of Pleasure, only need special consideration.



Phytophthora infestans, De Bary.

Explanation of Plate.

This plate was used by Prof. C. H. Fernald, to illustrate an article on the Potato Rot, which appeared in the Agricultural Report of Maine, 1882, p. 210. The plate was kindly loaned by Mr. Gilbert. In using it, we are aware that the occurrence of *winter*, or *oospores* is doubted by many botanists. The writer having never seen them is not prepared to advocate either view, though analogy would strongly suggest their existence. The plate represents fairly well the mycelium, conidiophores and conidia.

1. Section of a potato leaf showing three *mycelium* threads running between the cells, and two *conidiophores* extending from them down through a breathing pore (stomate) on the under side of the leaf. One has two lateral branches with *conidia* at the ends, while on the top of the main stem is borne a conidium from which zoospores are escaping.

(The figure is wrong in representing the terminal spore as the first to mature. The young conidia are formed at the ends of the branches. The lateral are the first to mature.)

2. Conidium showing swarming spores within.

3. A zoospore much enlarged and provided with cilia.

4, 5 and 6. Represent winter spores (oospores) claimed to have been seen by Mr. W. G. Smith, but doubted by most botanists.

7. Three zoospores swimming through water.

8. Three zoospores becoming spherical and losing the cilia.

9 and 10. The zoospores germinating and producing mycelium.

THE POTATO ROT.

Phytophthora Infestans, DeBary.

(*Peronospora infestans, Mont.*)

The Potato Rot, Blight or Rust, as it is variously called in Maine, was very bad in this State the past season. Many letters asking information regarding the nature of this disease and its remedies, were received at the Station. To meet the case a short exigency bulletin was hastily prepared. Below we give for permanent record a fuller and better considered account of the disease and its treatment.

Origin and History.

This disease has been known in America over fifty years. It has spread to all the potato growing countries of the world, causing more damage to the Irish potato than all other diseases combined. It is common on the wild potato from which our cultivated potato was derived. The wild potatoes are supposed to have been the original source of the disease. The disease also affects the tomato. For an excellent account of the history of Potato Rot, the reader is referred to "Diseases of Field and Garden Crops," by W. G. Smith, MacMillan & Co., London, 1884.

Primary Causes.

The *primary* cause of the Potato Rot, Blight or Rust, is a fungus parasite. It is as definite a plant as the potato, though much more simple in its structure and lower in the scale of vegetable life. It finds in the potato plant the conditions favorable for its growth and attacks it, producing the disease. It reproduces its kind, especially in the summer, by organisms called spores, which are as necessary for its continuance and extention as the seed of higher plants. The disease cannot spread except these spores are present any more than the potato can multiply without tubers.

(The disease can be produced in healthy plants by infecting them with the spores of this fungus. Plants protected from infection by the spores are exempt from the disease. This parasite is

always present in plants suffering from the Potato Rot. There are other rots, wet and dry, of various kinds, not due to *this* fungus which are sometimes confounded with it. The true Potato Rot may under different conditions be wet or dry.)

Secondary Causes.

There are several *secondary* causes which modify the disease when present. Moisture and heat favor the growth of the fungus. The disease is worse on heavy and poorly drained lands. The atmospheric conditions, the nature of the soil, the methods of culture, vitality of the plant, and the variety of the potato, have no power to originate the disease. They can only favor or impede its progress.

Conditions of Growth.

Warm weather and moisture at the time the summer spores are ripe and dropping, will cause them to germinate, therefore the disease is usually worse in hot, moist seasons. Should it be dry at the time the spores are ripe they soon die and the disease does not spread. The fungus seems to require a sufficient time to perfect itself before producing spores. It would produce spores earlier in early plantings and probably mature faster in early varieties. We often see early potatoes affected, while later varieties contiguous are exempt. Also early varieties exempt when later in the season the slower growing varieties alongside become diseased.

The fungus is most active when the temperature is between 60° and 70° F. At lower temperatures than 40° its developement is arrested, but it can survive a much lower degree. At 80° F and upward the spores are gradually killed. Extremely hot weather would be unfavorable to the germination of the spores. The disease does not appear in Maine until about Aug. 1st, and sometimes later, and often not before early varieties are ripe and harvested. If the source of infection is in the early potatoes when planted the disease appears earlier. If in later varieties it developes apparently later. The disease might spread from an early infected variety to a contiguous, uninfected field of later varieties, though there is reason for believing that the proper stage of developement of the potato plant is necessary for infection.

Description.

Mycelium.—The plant body of this fungus is composed of slender, jointless, transparent threads, which permeate the stem,

leaves and tubers of the host plant, running between the cells. The mycelium does *not* produce lateral branches (haustoria) for obtaining nourishment from the cells of the host plant.

Conidia.—The mycelium sends, during the summer months, slender branches (*conidiophores*) through the stomata or breathing pores of the under side of the leaves. The conidiophores are at first simple, but finally produce a few lateral, irregularly placed branches. They are attenuated at the apex and enlarged at the point where the conidia are located. The conidia or *summer spores* are borne on these branches. They are eliptical or oval bodies 27 to 29 micromillimetres in length, with a terminal projection at the base. The conidia are at first single at the end of the branches but finally become lateral by the outgrowth of the tip of the branch. Several spores may be produced in succession. These conidia may under proper conditions develope germ threads directly, which penetrate the breathing pores of the host, producing a new plant. More commonly the conidia produce *zoospores.* The contents of the conidia breaks up into several masses, which are finally liberated by a rupture of the wall at the small end. These minute, jelly-like (protoplasmic) bodies have the power of moving about with a jerky motion, like small animals, by means of two slender cilia or hairs attached to one side of the spore. On account of this power of motion they are called *zoospores.* The zoospores soon come to rest, lose the cilia, assume a rounded form and develope a thin membanous wall. Under favorable circumstances they send forth germ threads which penetrate the breathing pores of the potato leaves and become new plants.

Zoospores.—These are egg spores, resting spores, or winter spores as they are variously called. They are supposed to develop within the stem, leaves and tubers of the host plant and perpetuate the species. Though they are well known in related species, there is a difference of opinion regarding their occurrence in the Potato Rot.

The species has wonderful power of perpetuating itself. Some believe as winter spores in the stem, leaves and tubers; others regard the mycelium perennial in the stored tubers, and the seed the means of infection; others, (the writer belongs to that class,) do not believe the preservation of the mycelium in seed potatoes adequate to account for the continuance and spread of the disease. The writer believes there is some source of infection left behind

in the field when the potatoes are gathered. The mycelium may live over winter in potato tops and in the few tubers left in the ground.

The *zoospores* if they ever occur, may not ordinarily be produced and may not be always essential to the continuance of the disease. The known occurrence of oospores in related species, would in our estimation be stronger evidence of their existence in the Potato Rot, than the fact that they have not been seen by botanists, evidence that they do not ever occur.

Prof. Humphrey (Mass. Ex. Sta. bull. No. 6, 1889, p. 19), says: "The fungus doubtless survives the winter by the hybernation of the threads in potato tubers, but this method alone seems hardly certain enough to constitute the sole reliance of the plant."

He also says "that the existence of *winter* spores has never been satisfactorily proved."

Prof. G. W. Smith of England, claims to have found these spores in the leaves, stems and tubers, and figures them. The relatives of this fungus, the Downy Mildew of the Grape and others are known to produce winter spores, and by analogy, we would expect them to occur in the Potato Rot.

Prof. Scribner says: "The mycelium is perennial in the tubers and if these, containing this mycelial growth are used for seed, they are almost certain to carry infection to the new crop."

He does not apparently recognize any other means of survival.

We are inclined to believe that there is some means of continuing the disease in the soil after the crop is harvested. Whether this is by *resting spores* in the tops, leaves, rotten and small potatoes left on the ground, or whether the *mycelium* lives over winter in the tops and ungathered potatoes, is an open question. If the mycelium will live in the harvested potatoes we see no reason why it may not survive in the small potatoes and tops left on the ground. If potatoes left in the soil grow the next spring certainly the hardier fungus would probably survive. This matter is of fundamental importance. A definite knowledge of the winter conditions of this fungus is essential as a basis for intelligent application of preventive measures. A careful study of the possible winter conditions is of the greatest importance. It will probably be found finally that it has all the resources claimed.

Life History.

Whatever way the plant is infested, the mycelium or threads grow with it, enter the new shoots and finally penetrate the leaves.

When the plant or fungus or both have sufficiently grown, which occurs during the summer and fall months, fruiting branches are developed on the threads. These find their way through the breathing pores of the leaves, and bear the summer spores, which are developed in great numbers and blown by the wind on other plants. These spores germinate, with favorable conditions, and develope new threads, or they produce several oval shaped spores which have two vibrating hairs, by means of which they move about in water, and finally coming to rest, also produce threads. These threads enter new plants and spread the disease. The spores develope rapidly and germinate quickly, so that from a few diseased plants a large patch, under favorable conditions of moisture and heat, may be destroyed in a single day. The fruiting stalks and the mycelium from the germinating summer spores, stop the breathing pores of the plant, preventing a proper circulation. This causes rapid decay of the tissues of the plant, which turn black, becoming slimy and ill-scented. The developement of the summer spores, causes the leaves on the under side, to present a grayish mildewy appearance. Some of the summer spores fall upon the ground and are washed into the soil by rains, reach the tubers and infest them. It is supposed that the threads of the fungus go down the stems after killing the leaves, and finally reach the tubers. It is known that "potatoes covered with from 1 to 3 inches of earth are pretty certain to become diseased if the fungus is on the tops, while those planted four inches deep are more rarely infested." Prof. Scribner argues from this, that if the spores reach the tubers through the soil, those near the surface would be most affected. Would not the tubers near the surface be affected first, by mycelium descending the stem? The roots bearing them come off higher up. Are not the conditions near the surface more favorable for the rapid growth of the fungus, and possibly the infection near the surface greater from this cause? Unless the tubers are harvested before they are infected, they begin to rot in the ground, and the loss may amount to 50 per cent. of the crop. If any of the harvested potatoes contain the fungus, the disease will spread in the pits or cellar, from potato to potato. Potatoes harvested and stored damp, are likely to become infected from the germination of summer spores which fall upon them while being harvested. This completes the round of life.

For cuts and explanations see pp. 172-3.

REMEDIES.

The methods of treatment are direct and preventive. From the fact that the parasite is internal and only appears at the surface while producing summer spores, the methods must be largely preventive.

Direct Methods.

Any means by which the growth of the *summer spores* can be checked, would prevent the spread of the disease from plant to plant during the summer season, and prove beneficial.

The application of copper compounds to destroy the summer spores, has been quite extensively tried the past season at several of the Experiment Stations and elsewhere, with satisfactory results. We would recommend them for careful trial in Maine.

Solutions.

No. 1.—Mix 1 qt. of 22° ammonia water (hartshorn) with 3 ozs. of carbonate of copper. Stir rapidly until a clear liquid is produced. When ready to use it, dilute to 22 galons with water. Apply with a spraying apparatus or force pump.

No. 2.—Dissolve 2 lbs. sulphate of copper (blue stone) in hot water, dissolve and add 2 1-2 lbs. bicarbonate of soda. When cool, add 1 1-2 pints of commercial ammonia water. Dilute to 22 gallons with water. Apply as stated above.

No. 3.—Dissolve 6 lbs. copper sulphate in 16 gallons water. Shake 4 lbs. of fresh lime into 6 gallons of water. When cool mix the above solutions slowly and thoroughly and apply as stated above.

Any one of the copper compounds prepared as stated above will do, though the first two are easier prepared and applied. If 26° ammonia is used add one-third more water. Paris Green in water (1 lb. to 80 gallons) could be added and applied at the same time for the potato beetle. London purple is regarded by some as preferable to Paris Green and if used should be added 1 lb. to 100 gallons.

Remarks.

Use a force pump with brass fittings to apply these mixtures as copper compounds corrode iron. The nozzle should have a fine spray that will cover the foliage well and not drench it. The

Vermorel nozzle sold by Thos. Sommerville & Sons, Washington, D. C., price $1.50 will be found the best, if recipe No. 3 is used. The Nixon Nozzle, (Nixon Nozzle & Machine Co., Dayton, Ohio,) or any other nozzle giving a fine spray will answer the purpose, to apply the others. Make the application immediately after a rain, or when fair weather is expected. Repeat if the mixture is washed off by a hard rain. Apply about the time the disease usually appears or anticipate it, or watch the field and spray *immediately* on the *slightest appearance* of the disease.

Preventive Methods.

The following preventive measures are equally applicable, whether the theory of winter spores is adopted or rejected. The presence of the mycelium in decaying potatoes, or in the stems, leaves and tubers left in the field, would make it advisable to destroy all potato refuse.

1. Burn the tops and leaves in the fall after the crop is gathered. This is based upon the belief that winter spores are developed in the stems and leaves, or that the mycelium may possibly hybernate in them.

2. Gather all the small potatoes. As the mycelium hybernates in stored tubers, and possibly winter spores also occur in them, they would no doubt survive in potatoes left on the ground.

3. Select seed for planting, from fields or localities exempt from the disease the previous season. Great care should be exercised in selecting good seed. It is believed by some that diseased tubers are the *principal* means of infection.

4. Rotate the potato crop. This is based upon the belief that the means of infection survives the winter in the potatoes, stems and leaves left in the soil.

5. Burn all decayed potatoes taken from the cellar, or bins and all other potato refuse, do not throw them on the compost heap, as the fungus retains its vitality and is spread far and wide with the manure.

6. Plant early in the season and those varieties that mature early. This is based upon the belief that the fungus does not mature until the warm summer months, and therefore early plantings and early varieties would escape the disease from outside infection.

7. If cut seed is used, the surface should be allowed to dry, for when placed in the ground, the fungus if present, would find ready entrance to the tubers through the freshly cut surface. This is based upon the belief that the means of continuing the fungus occur in the soil.

8. If varieties less subject to the attack of the rot can be found, select them for growing.

9. Potatoes affected should be dug immediately and marketed, as the disease rapidly spreads to the tubers in the ground, and is almost sure to spread in the bin if they are stored.

10. Thoroughly dry potatoes before storing them, for, if damp, summer spores lodged upon them will germinate and develope the disease in the pit or cellar.

11. Store in a dry, cool place and keep dry, as warmth and moisture favor the growth of fungi.

12. Sort the potatoes in the cellar occasionally, and remove the infected ones, as the disease will spread from tuber to tuber.

If a dry place is not obtainable, then dust the potatoes with dry air slaked lime at the rate of one bushel of lime to twenty-five of potatoes.

14. Plant on a sandy loam, or a well drained soil, as the moisture of a heavy or poorly drained soil favor the disease.

15. Plant in narrow patches running at right angles to the prevailing summer winds. This is based on the fact that the disease usually starts from a few infected plants and the disease is spread by the wind.

16. It has been recommended to soak the tubers for 24 hours in a solution of copper sulphate, 6 ozs. dissolved in water enough to cover a bushel.

17. It has been shown that the fungus is destroyed by keeping the tubers for a few hours at a temperature of 105° to 110° F. a degree of heat that does not injure them for seed. This is a promising method, as it would thoroughly disinfect the seed a source of the disease.

18. Deep covering of seed and deep covering in cultivation have been recommended. It is believed that deep planting is unfavorable to the fungus, and that the summer spores can not reach deep covered tubers so readily.

19. Do not go through an uninfected patch after walking through an infected field, the spores will be carried on the clothing and spread the infection.

20. Do not plant early and late varieties contiguous.

APPLE SCAB.

Fusicladium dendriticum,

PLATE V.

This plate was prepared in stipple crayon after the colored plate by Geo. Marx, (Pl. II, U. S. Agr'l Report, 1887) by Miss Hannah Lord, of Orono, Me.

Fig. 1. Apple affected by the scab.

Fig. 2. Leaf of apple affected by the scab.

Fig. 3. Section through a portion of a scab spot on the fruit, showing the growth of the fungus; greatly magnified.

Fig. 4. Spores of the fungus greatly magnified; four of them germinating.

Experiments were conducted the past season with fungicides, upon the Apple Scab, in Michigan and Wisconsin by Professors Taft and Goff; under the auspices of the U. S. Dept. of Agriculture, and through the kindness of Prof. Galloway we are able to record the following results:

These gentlemen experimented with several compounds, but the copper salts were so much superior to all others, that they alone deserve consideration.

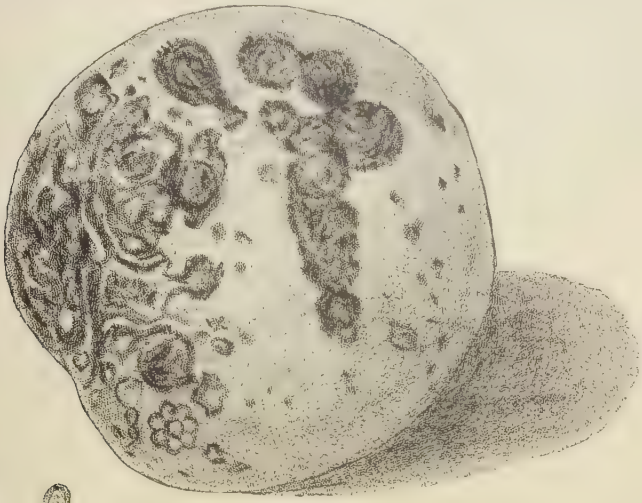
They recommend spraying just as soon as the buds begin to swell. In their experiments they sprayed seven times during the season, making the last application about Aug. 10th. In ordinary seasons our or five applications would be enough. They recommend the following:

Ammoniacal Carbonate of Copper Solution.

1. Dissolve 3 ounces of carbonate of copper in 1 quart of 20° ammonia water and dilute to 32 gallons.

Modified Eau Celeste.

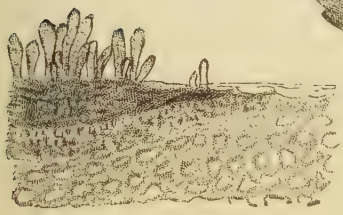
2. Dissolve 2 lbs. copper sulphate in hot water, and in another vessel dissolve 1 1-2 lbs. bicarbonate of soda; mix the two and when cool, add 1 1-2 pints of 20° ammonia water and before using dilute with water to 32 gallons.



1

4

2



3

APPLE SCAB.

(Fusicladium dendriticum.)

After Geo. Marx, by Hannah Lord.

We give below a copy of table showing the results of these experiments:

	Professor Goff's experiments.					Professor Taft's experiments.					
	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Total yield.
		%	%	%	cts.		%	%	%	c. s.	lbs.
Potassium sulphide	7	30.04	48.55	21.41	.37	7	25.5	74.3	.2	.39	1,615½
Sodium hyposulphite	7	43.24	42.78	13.98	.29	7	28.6	75.4	.89	.23	1,648
Sulphur powder	7	32.72	54.31	12.97	.31	6	17.6	81.2	1.1	.31	1,485½
Am'l copper carbonate	7	75.02	23.35	1.63	.38	7	51.2	48.6	.16	.49	2,112½
Eau celeste						7	68.8	31.0	.2	.60	1,675½
Sulphur solution	3	¼ .9	48.99	8.11							
Unsprayed		23.31	53.89	24.71			12.5	86.7	1.8		769½

"*Results.*—The copper solutions remained persistently on the leaves, even resisting heavy showers, which washed off all traces of the sulphur compounds, and when the leaves fell in October traces of copper could still be see on them."

"At time of harvesting Professor Taft picked all the apples on the trees and assorted them into three lots, of first, second, and third quality. The first class contained those free from scab, the second those slightly scabby but not distorted or under size, the third those that were distorted or under size. Those in each class were counted and the percentage which they formed of the whole estimated.

"At Ithaca, Wis., the apples were not all picked, but a market-basket holding about 1½ pecks was first filled with apples from the lowest branches of one of the trees. Next a similar basketful was picked from the branches that were just the height one could conveniently reach, taking care to pass clear around the trees in both cases. After this a basket of one-half a bushel was filled from the tallest branches of the tree. The apples were then poured upon an assorting table; and the baskets filled and emptied again in the same manner and from the same tree, after which the contents of the six basketfuls were assorted into three qualities as in the preceeding case."

"It is evident from the tables that the sprayed trees, especially those sprayed by copper compounds, producing a much larger percentage of healthy fruit than the unsprayed. The greatest difference between the perfect fruit on sprayed and unsprayed trees under Prof. Goff's charge was 51.68 per cent. and the least 6.7

per cent. The greatest difference in those under Professor Taft's charge is 56.3 per cent. and the least 5.1 per cent., the two results being essentially the same.

Besides the tabulated results there were others which are of great importance but can not be estimated in exact figures. A scabby apple is much smaller than a healthy one, and in many cases, while the apples could not be placed in class one, the scab had so been held in check that the fruit had obtained a greater size than it otherwise would. Professor Taft gives the difference in weight between perfect and scabby fruits as varying from .037 to .002 pound for each apple, and says the scabby apples are 10 per cent. smaller than the perfect ones, making a difference of nearly a bushel per tree in size alone, besides the fact that the apples that are badly scabby are unmarketable. "From the combined effect of the two causes," he says "we lost on some trees a barrel of apples."

"The cost of the chemicals and labor expended varied but slightly in the two cases, but both gentlemen were obliged to buy chemicals in small amounts, and the cost per tree would be greatly lessened by treating a large orchard and buying materials in quantity. Professor Taft used large trees requiring three gallons each for each application, while Professor Goff used three gallons for the two trees, but Professor Goff estimates the labor higher than Professor Taft, and this makes the figures nearly alike. Both these estimates, however, are for seven applications. In an average season, and with the copper solutions, four or at most five applications will probably be sufficient. It is likely that in a large orchard with average sized trees, when the chemicals were purchased by the quantity the expense could be reduced nearly one-half. The expense of the ammoniacal solution in particular would be reduced by purchasing the copper carbonate instead of preparing it from the sulphate."

In Mr. Goff's calculations the cost for labor in making the treatments amounts to more than half the expense.

It seems probable that it would be profitabe to make the first application earlier than was done this year, and there is no reason why this application, or the next should not be combined with London Purple, or some other insecticide, and the tree protected from insects and fungi at the same time. Mr. Hatch closes his report thus:

"What we now need is to determine the correct amount of the copper mixture to use, the times best suited to its application, and what combinations to make with insecticides, and a new era in fruit culture will be inaugurated."

FALSE FLAX, OR GOLD OF PLEASURE.

Camelina sativa, (Crantz.)

This weed may be known by the following description: Pod pear shaped, pointed, swollen, flattish parallel to the broad partition that divides the pod into two cells; valves with one nerve. Seeds numerous, oblong and some larger than a flax-seed. Flower, small, yellow. The plant is an annual, has lance shaped, or arrow shaped leaves and a large margined pod Introduced from Europe where, it is used somewhat for the oil contained in the seeds, known as Oil of Pleasure. The stem yields a fibre sometimes used for making sacks, rough paper and brooms. We call attention to this weed as it has appeared in the State and though perhaps not so bad as the black mustard, yet it belongs to the same family and has the same habits and if allowed to spread will add one more annoyance to the farmer. Below we copy a letter, regarding this weed that appeared in the *Maine Farmer*, which may be interesting:

Mr. Gilbert, Dear Sir:—I enclose a weed taken from a field of oats on the farm of Lincoln Sprague in South Presque Isle. The field consists of about two acres sown with oats raised by himself. One-half of the piece was sown with a quantity of Bradley's superphosphate. On the half sown with the phosphate the oats are full of the weed, while on the other half the weed is not to be found. It is a new weed in this section. Please tell me the name of the weed? I would like to know at the same time if foul seed is one of the ingredients used in manufacturing superphosphate? Yours very respectfully,

PRESQUE ISLE, July 27.

H. H. COOK.

[Will Prof. Harvey examine and report to *Maine Farmer?*]

Z. A. GILBERT.

Z. A. Gilbert, Dear Sir:—The weed which you enclose for determination belongs to the mustard family (Cruciferae) and is known to botanists as *Camelina sativa*, Crantz. The common name is False Flax or Gold of Pleasure. The name Wild Flax is in allusion to the fact that it is a weed in flax fields and was supposed by the ignorant to be degenerate flax. The plant has been

grown for the seeds, which yield an oil superior to rape seed oil for burning. The stems also yield a coarse fibre which is suitable for sacks, brooms and rough packing paper. The plant is a native of France, introduced with seed to this country, where it has gained only the reputation of a detestable weed. The plant seeds profusely, and a few scattering plants allowed to go to seed would the next season produce an abundant harvest. The best way to get rid of it is careful cultivation in some hoed crop. The plant being an *annual* would be exterminated if not allowed to seed. It does not seem possible that the seed could have been introduced in Bradley's phosphate as suggested by Mr. Cook. He could satisfy himself on this point perhaps by noticing whether the weed occurs in other fields where Bradley's phosphate was used. It is more probable that a few seeds were introduced last season from some source, and the plants escaped notice, and seeding so abundantly have apparently come suddenly the present season. Their being confined to one side of the field may be explained readily by supposing that the plants which produced the seed for this season's crop grew upon that side of the piece, and that became a centre of distribution, which happened to be the same ground on which the phosphate was used. We should like to know the history of the field, upon which the weed grew, for the last three years, and whether the weed is found elsewhere. Look especially about the railroads, as they bring many weeds in ballast and upon freight, and even the cars themselves transport seeds which the winds have blown upon them. The packing material thrown out by merchants is often the source of introduction of vile weeds. A phosphate might introduce into a field the seed of a weed which had accidentally got into it during transportation, but it would be unjust to hold the phosphate responsible.

Orono, Me., Aug. 2nd, 1889.

F. L. HARVEY,

Botanist for the Station.

RIB GRASS, OR ENGLISH PLANTAIN.

Plantago lanceolata, L.

This weed belongs to the Order *Plantaginaceae* (Plantain Family) and may be known by the following description:

Root living from year to year; stem grooved, angular, nine inches to two feet high; leaves hairy, narrow, three to five ribbed and in a cluster at the root. The flowers small, whitish, borne in a thick short spike at the end of the long flower scape. The pod opens at the top by means of a lid and allows the two oblong boat shaped seeds to escape. These seeds are smaller than clover seed and may be distinguished by the brownish color, oblong shape and hollow or groove on the inner face. They look like a diminutive boat. Attention is especially directed to this weed, as it is being introduced into the State in clover seed. Complaints have been received of fields over run with it, that were seeded to clover. The seeds of the plantain being smaller and duller colored are liable to escape notice, being hidden by the bright yellow color of the clover seed. Great care should be exercised by farmers in purchasing clover seed, so as not to introduce this detestable weed. We hear complaints of its occurrence in other States. Being a perennial it is a hard weed to exterminate. It is hardy and will cover the ground with a mat of leaves. Cultivation in a hoed crop would be the best way to control it.

Accompanying this Report is an envelope containing New York Red Clover seed, adulterated with about ten per cent. of Rib Grass seed, (*Plantago lanceolata, L.*) This seed was purchased at a prominent seed store in Maine and was highly recommended. We distribute the material that farmers may learn to distinguish the seed of Rib Grass and avoid it.

INJURIOUS INSECTS.

The past season has been remarkable for the injurious insects that appeared in unusual numbers.

Forest Tent Caterpillar.

The Forest Tent Caterpillar was especially abundant in the forest along the Canadian Pacific in the vicinity of Sebois, where it occurred in such great numbers on the railroad track as to grease the rails and impede the movement of trains. It fed principally on the poplar, but when its favorite food was wanting, repasted upon the foliage of the Oak, Cherry, Maple, Willows, Elm, Gray Birch and other trees. In the Penobscot Valley it was unusually plentiful, causing much annoyance and considerable damage to orchard and shade trees. They transformed in abundance and many eggs were laid and unless they meet with mishaps the pest will be plentiful in 1890. (History shows that they are not abundant many years in succession, as parasites increase and check them.) Crushing with the hand, burning with a torch, and applications of kerosine or strong soap suds to the caterpillars when in bunches, were the methods resorted to to destroy them. This winter some have carefully removed from the apple trees, all the clusters of eggs they could find.

The Codling Moth.

The Codling Moth did much more damage apparently than usual. Probably the insect was no more abundant, but it being a shy bearing year the effect was more noticeable.

When the trees set much fruit, some of our orchardists regard the Codling Moth a blessing, as they do the proper thinning. The apples affected by the first brood all drop, and in a good year enough are usually left. The greatest damage is done by the second brood. The caterpillars have insufficient time to mature before cold weather checks their work, but they have so far progressed that the calyx of the apple is badly eaten. The worms are not large enough to transform and probably many of the second brood in Maine perish. The work of the second brood in Maine does not affect the core, only a portion around the calyx being damaged. The apples are blemished, which injures them

for market. This season three-fourths of the apples from some sections showed the work of the second brood Codling Moth.

Answers to questions sent out by the State Pomological Society to Fruit Growers, indicate that from 10 per cent. to 50 per cent. of the apple crop in Maine is damaged by this insect. We regard it the most injurious insect to the apple in the State. Though when not too abundant it may prevent over bearing, yet it would seem that it has already far exceeded its sphere of usefulness in that direction and should at least be checked. It can easily be managed by spraying with Paris Green, or London Purple, and there is no reason why orchardists should suffer from its ravages. Especially should the matter receive attention when the trees show light bloom and a short crop is inevitable. The subject of spraying and spraying apparatus is considered elsewhere in this Report.

Various other Insects.

The Fall Canker Worm and the White Marked Tussock Moth were reported from several localities and appear to have been much more abundant than usual. They were feeding on the foliage of apple trees. The May Beetle was reported as doing much damage to grass lands in some parts of the State. The above insects will be considered more fully at some future time.

THE APPLE MAGGOT.

Trypeta pomonella, Walsh.

Order Diptera, Family Trypetidae.

Bibliography.

Walsh.—In Amer. Journ. Horticul., Dec., 1867, pp. 338-343; 1st Ann. Rept. Insects of Ill., 1868, pp. 29-33, figs 2, 2a, (Original description.)

Walsh, Riley.—American Entomologist, 1, 1868, p. 59, (prob. ident. of insect, from N. Y.)

Loew.—Monograph Diptera N. A., Pt III, 1873, pp. 265-268, (description and remarks.)

Glover.—M S. Notes Journ. Diptera, 1874, p. 58. Pl. 9, fig. 14, (brief reference and authority.)

Packard.—Guide to the Study of Insects, p. 415.

Comstock.—Report Comm. Agr'l., 1881-2, pp. 195-198, Pl. 14, (operations, larva, pupa, imago, remedies.)

Saunders.—Fruit Insects, 1883, pp. 135-136, fig. 143, (brief account, illustrated.)

Cook.—Country Gentleman, 1884, p. 857, (habits and occurrence in Mich.); 14th Ann. Rept. Mich. St. Hort. Soc., 1884-5, pp. 200-203, figs. 1-3, (general notice); Mich. Farmer, 1884, Vol. 15, No. 41, p. 4; Rural New Yorker, 1885, Vol. 44, p. 360.

Lintner.—Bull, N. Y. Agr'l. Expt. Station, LXXV, Dec. 1883, (description and habits;) Second Ann. Rept. Entomologist St., N. Y., 1885, p. 117, (description, life history, distribution, remedies, desiderata in life history, related species.

Cutting.—Report Board Agr'l. Vt., 1883-4, p. 259. Reprint of Comstock's paper, from U. S. Agr'l. Rept., 1881-2.

Goding.—Fruit Growers Jour., Cobden Ill., Apr., 1885.

Treat.—Inj. Ins. to Farm and Garden, 1887, p. 164. Brief account. Illustrations of Flies, larva, pupa and work of larva.

Perkins.—Second Annual Report, Vt. Expt. Station, 1888, p. 134.

Harvey.—Ann. Rept. Maine St. Coll. Expt. Station, 1888, p. 175, also reprint in Agr'l. Report of Me., 1888, p. 139; Me. St. Coll. Expt. Station Bull. No. 2, Second Series, 1889.

Riley.—Amer. Agric., July 1872, V. 31, pp. 263-264, 2 figs; N. Y. Semi-Weekly Tribune, 15 Dec., 1876: Amer. Ent., July 1880 (V. 3) N. S., V. 1, pp. 159-160: Stoddard's Encyclopædia Americana, 1883, V. 1, p. 135.

(*a*) Comparative descriptions and figures of larvæ, pupa and imagos of *Trypeta pomonella* and Carpocapsa pomonella; figures showing injuries of both species; distribution and means against Trypeta.

(*b*) Description larvæ, pupa imago; ravages, food plants, habits, means against, literature.

(*c*) Example of acquisition of new habits in insects.

Cook.—Rept. Mich. Bd. Agric. 1889, p. 152; Rept. Mich. Expt. Station 1889, p. 97, (attacks plums and late cherries in Michigan.)

Cordley.—Orchard and Garden, 1889, Vol. 11, No. 10, p. 192, (records occurrence in plums and cherries in Mich.)

Davis.—Ohio Farmer, Nov. 1889, (records occurrence in plums and cherries in Mich.)

Trans. Me. St. Pom. Soc'y.

1882.—p. 101, Extracts from Prof. Comstock's paper in U. S. Agr'l. Rept., 1882, p. 195. Supplementary remarks to above by S. C. Harlow.

1883.—p. 30, Hon. Robt. H. Gardner; p. 43, T. S. McLellan; p. 61, Hon. Z. A. Gilbert.

1884.—p. 70, L. H. Blossom.

1887.—p. 9, Remarks by the Secretary D. H. Knowlton; pp. 84-85, Prof. Carl Braun; p. 101, P. M. Augur.

1888.—p. 26, Pres. Chas. S. Pope; p. 56, Prof. Maynard; p. 114, Questions to fruit growers by Sec'y. Knowlton; p. 117, remarks by Committee on Lists of Fruit.

The above Transactions also occur in the Maine State Agr'l. Reports of the corresponding years.

History and Distribution.

Both the fly and the maggot of this species appear to have been observed many years before Walsh published his original description in the American Journal of Horticulture, December 1867. Walsh states that he bred the flies from maggots found

in wild haws, (thorn apples or thorn plums, as they are variously called,) five or six years before his description appeared. The flies and maggots were known in the Eastern States several years before 1867, and at that date their ravages upon cultivated apples claimed serious attention in New York, Massachusetts, Connecticut and Vermont. To Walsh belongs the credit of showing, that the maggots affecting cultivated apples were the same as those he found in haws; and that the beautiful fly known in the cabinets of Eastern Entomologists, was an undescribed American species of Trypeta and the perfect form of the Apple Maggot.

Prof. Cook records its occurence in wild haws in Michigan, Illinois and Wisconsin. Prof. Comstock bred it from a species of haw (*Crataegus*) growing upon the agricultural grounds at Washington. We find no reference to its having been found elsewhere in haws. We have not found it in haws in Maine. The published statements regarding its universal distribution in haws are not based on *observation*. There are no positive observations of its feeding upon wild crab apples, (Pyrus). Walsh says it feeds "*probably* upon our native crabs." Comstock and Lintner write me they did not record its occurrence in crab apples from personal observations. The wild crab apples are hard during the time the flies are on the wing and would not appear to us to be a proper nidus for the maggot. The writer lived twenty years in the Mississippi valley where crab apples are common and did not see Trypeta. Prof. Cook has not found it in crab apples but writes us that Trypeta has been found the past season (1889) in Michigan infesting plums and late cherries. In considering the history and distribution of this insect outside of Maine, we can do no better than take extracts from Walsh, Comstock, Lintner and Cook.

In 1866 Walsh had knowledge of its occurrence in Massachusetts, Connecticut, New York and probably Vermont.

In New York it was prevalent at the Oneida community; North Hempstead, L. I. and occured generally through the Hudson river country. In Massachusetts at East Falmouth. Its occurrence in Vermont in 1867 is uncertain. In July 1867 Walsh bred the flies from maggots received from Connecticut, Massachusetts and New York.

Comstock in 1881 records its occurrence in New Hampshire, where, according to Mr. N. W. Hardy, it had infested the early varieties in the towns of Hancock and Dublin for the last six

years. He had personally observed it for several seasons in one of the orchards of Cornell University, N. Y., infesting a few varieties.

Lintner writes in 1885: "The most serious account of its injuries have been received from Vermont. In New Hampshire in a few localities it has ruined entire orchards, (Rept. Comm. Agr'l. for 1881, p. 190.") * * * "Mr. L. L. Whitman writes from North Auburndale, Mass., I had hundreds of bushels of the finest fruit rendered worthless by the apple maggot last year." "From Franklin, Delaware County, N. Y., larvae have been reported." Personally Prof. Lintner captured the flies occasionally at Schenectady, N. Y., from the 3d to the 27th. of July.

Prof. Cook in 1884 writes: "Last year I received specimens from Delavan County, Wisconsin, with the information that it was doing great damage. This year the enemy has attacked us on our own ground. I know from personal observation that in Michigan in Ingham and adjoining counties it has wrought considerable mischief."

The following predictions made by Walsh in 1867 are almost prophetic. "There can be but little doubt that the descendants of the improved and highly civilized apple maggots in the East will, in processs of time and by slow degrees, spread gradually to the West, or they may be suddenly introduced in a barrel of Eastern apples into some point at the West, and thence radiate in all directions and colonize the country."

We find no mention of its occurrence in Maine in any publication outside of the State. In the State it is referred to in the Agricultural and Pomological Society Reports, in newspaper accounts and in a recent Bulletin issued by the Expt. Station at Orono.

The pest was undoubtedly introduced in Maine in early fruit shipped from adjoining States. Mr. T. S. McLellan, (Me. State Pom. Soc'y Rept., 1883, p. 43) says: "Some five or six years since, I noticed that the earliest sweet apples we received from the South were infested with a minute worm, which had thoroughly perforated the fruit. Three years since, I noticed my earliest sweet apples were similarly affected, and last season all my sweet apples and most of my pleasant tart apples, such as the Haley, Hurlbut, Nodhead, Primate and Porter were more or less infested." Our observations confirm this as we have the past

season found early apples, shipped from Boston and exposed in the Orono and Bangor markets, literally alive with Trypeta larvæ.

Mr. McLellan also refers to its occurence in the northern part of Somerset County at that time.

Mr. Harlow (Me. St. Pom. Sec'y Rept. 1882, p. 104) says: "This insect seems to have increased to such an extent in our State within a few years as to cause serious alarm among fruit growers." The above would indicate that the pest was, in 1882, well established in Maine.

Mr. S. R. Sweetser, of Cumberland Centre writes: That in August 1880 he first noticed the flies on King Sweets and the same season the larvæ were found in Talman's Sweets.

Mr. D. H. Knowlton, (Me. State Pom. Soc'y Rept. 1887, p. 9) says: "In some parts of York, Cumberland, Sagadahoc, Kennebec and Androscoggin counties the insect has already become a great pest and its increase may well be regarded with alarm."

Mr. Augur, (Me. State Pom. Soc'y Rept., 1887, p. 101,) says: "We have been exceedingly troubled with the apple maggot; so much so that it has broken our confidence in some varieties, so that we have hardly dared to sell them, we have found them so generally affected."

Mr. Sweetser, who has been much annoyed by this pest, writes: "That his apple crop was poor this season(1889,)and badly affected with maggots. That his neighbors, who have not been troubled with the fly much before, complain that their apples are badly affected this year." Reports from many places show that the pest has done much damage in the State this season.

Mr. Chas. S. Pope, (Me. Pom. Society Report 1888, p. 26,) says: "This troublesome insect is now found in several counties in the State and is doing much damage to fruit. The insect seems to work mostly in fruit grown in sheltered places, around buildings, or in places otherwise protected from the cold winds. So far as our observation extends they are not working very much in the orchards of the State, except as noted above."

Mr. D. H Knowlton, (Me. Pom. Rept. 1888, p. 117,) says: "Its ravages, though extending over a large part of the State, seem to be confined mainly to sheltered areas and have not yet generally injured the fruit grown in the larger orchards."

The observations of the writer so far as they go confirm the above statements.

The writer has examined many varieties of apples during

the past two seasons from various parts of the State and his observations show that the pest is on the increase, becoming gradually more widely distributed, doing greater damage where it occurs and constantly extending its depredations to new varieties and new orchards.

Through correspondence, personal observation, the examination of many varieties of fruit from many localities of the State, and through questions sent to fruit growers by the St. Pom. Soc., we glean, that the pest does the most damage in the western part of the State, and is widely distributed in Oxford, Lincoln, Somerset, Franklin, Androscoggin, Kennebec, Cumberland, Knox, Waldo, Sagadahoc and York counties.

The writer has found it in the Penobscot Valley at Stillwater, Veazie and Bangor, and the towns of Charleston and Corinth, in Penobscot County and at Bucksport in Hancock County. In the answers to the Pom. Soc. questions it is reported from forty-four localities in the State. We have no knowledge of its occurrence in Piscataquis and Washington counties.

Mr. W. P. Gerrard, of Caribou, Me., writes us that apples from Plymouth, Levant, Garland, Corinth and Dexter and other towns in Penobscot County, sold in Aroostook, are often badly bored by maggots, but he has not seen it in Aroostook grown apples.

Introduction.

Since the introduction of the Apple Maggot in Maine, eight or ten years ago, it has done enough damage each year to attract the attention of fruit growers. It has been considered in the Reports of the State Pomological Society almost every year for the last eight. Accounts of its ravages have frequently appeared in the public prints. During the last four years the writer has received many letters regarding it.

Its ravages have gradually increased. Each year it has extended its depredations further, until it is now nearly State wide in its distribution. It has gradually spread from variety to variety until a large per cent. of the varieties of apples grown in Maine are known to be affected by it.

Its distribution is so wide and its annual depredations so great, that it seriously threatens the fruit interests of the State and therefore, a consideration of its life history is a matter of State importance.

When the Experiment Station was organized two years ago, and an Entomologist appointed, it was decided to make a careful study of this insect.

To thoroughly investigate an insect the first step necessary is to make out its complete life history. With a knowledge of its life changes the weak points are made known and advantage can be taken of them in devising methods to hold it in check or destroy it.

Knowing that prominent Entomologists who had written about *Trypeta pomonella*, differed much upon several points in its life history; and also aware that its eggs and egg laying habits were *entirely* unknown; plans were laid to carry out a series of careful observations, embracing a study of the whole life of the insect and an investigation of the subject so far as possible in all of its bearings.

It became apparent at once from the nature of what had been written, that it would be impossible to glean the true from the false, and therefore hazardous to accept any statement, however noted the authority, without a careful verification.

During the last two years, under the most favorable circumstances, we have carefully reviewed all the published statements, accepting such as were verified and rejecting what appeared untenable.

The material at our command has been ample. Hundreds of infested apples of many varieties have been inspected. Maggots by the thousand; hundreds of pupæ; thousands of eggs, taken from the apples and from the ovaries of the females; and over two hundred flies, bred or captured about the trees, have been examined. From these examinations we have found reason to correct many statements, confirm others and add much that is new, especially about the eggs and reproduction of this insect.

We have been materially helped in our investigations by the aid and encouragement of others. In fact, without the assistance so cheerfully given by many, our work would have been impossible. We desire especially to thank Mr. Chas. S. Pope, Mr. J. W. True, Hon. Z. A. Gilbert, Mr. D. H. Knowlton and Mr. S. R. Sweetser, members of the Pomological Society, for specimens sent, observations made and kind encouragement in the work. We are greatly obligated to Mr. L. H. Merrill, of the Experiment Station for photographic work, to Profs. Riley, Comstock, Lintner and Cook for answering questions, loaning literature or aiding in

the bibliography of this insect, and to Prof. Riley for use of cuts. Prof. Jordan has taken a personal interest in following the researches. By his liberal policy the work has been advanced and this report so fully illustrated. Many points, not of especial economic importance, but of zoological consequence, have been incorporated in this Report, it being the present policy of this Station to record in its Bulletins all the results of research, both technical and practical.

We feel gratified that circumstances have enabled us to make these important investigations. It cannot be hoped that the work is entirely free from error, but an endeavor has been made to faithfully record what the eyes have seen. The cuts illustrating this Report, so far as they are original, were made by the writer, or photographed from microscopic preparations made by him, and may be regarded, as to outlines, reasonably correct. The drawings of the male and female flies were modified from Prof. Comstock's cut in the U. S. Dept. of Agr. Rept., 1881-2. We have also included *unchanged* from the same plate the excellent figures of the pupa, jaw system, cephalic and caudal spiracles, and a plate illustrating Pomace Flies.

The work is humbly submitted as a contribution to the life history of this insect, with the hope that it may aid somewhat in an intelligent struggle with this serious pest.

Sketch of Work, 1888-9.

The investigation was commenced under great difficulties. The way had to be felt step by step. At the time we began work Trypeta was unknown to us about Orono. The complaints were mostly from the Western part of the State. The material for study had to be sent by mail or express from the infested district.

Work began July 5th, 1888 upon the Benoni, a sub acid, early autumn variety. The apples at that date were about three-fourths of an inch in diameter. Observations were continued that season until Nov. 6th. Though this variety was regarded by some as an unlucky choice, and that an early sweet apple would have been better, yet the results show it served the purpose well. We selected this variety because it was badly affected in 1887, and because it was an autumn variety and would enable us to continue the investigation later in the season. Though this variety was made the basis of regular observations many other varieties were incidentally examined.

Fifty-two lots of apples, embracing several hundred specimens of many varieties, were regularly examined in 1888. These studies referred largely to the maggots, pupæ and the flies. In 1889 an investigation of the eggs and the egg laying habits was carried on in the labaratory and field.

We spent a week in Cumberland County in July 1889, studying the flies and their egg laying habits. Observations were made and recorded upon the following points:

(a) Larvae: First appearance in fruit; time required to mature; date of first maturity; conditions affecting rate of growth; time they remain in fruit after it is mature; time they first leave the fruit; nature of exit; time the larvæ remain in late fruits; first and latest pupæ formed; where the larvæ spend the winter; number of larvæ in a single fruit; presence of larvæ in hanging fruit, marketed fruit, windfalls; presence of larvæ in imported fruit; varieties affected, number and kinds; distribution in the State.

(b) Pupæ: Depth they go into the ground to transform: their occurrence in decayed fruit, on the surface of the ground, about grass roots and in apple barrels and bins; time required to transform; will they transform uncovered in dry jars under ordinary conditions? will they transform in bins and barrels kept in damp cellars? will earlier pupæ transform earlier in the spring? the time late pupæ transform.

(c) Flies: Number of broods; time of appearance in confinement and in nature; time they are on the wing in nature; relative number of males and females; feeding habits; time of life; copulation; nature of the ovipositor; method of laying eggs; puncture made by ovipositor; nature of internal reproductive system of female; male genitalia; what depth of earth will prevent the flies from transforming.

(d) Eggs: Number laid; time of laying; method of laying; position in the fruit; distribution in the fruit; development in the ovaries of the female; relation of Codling Moth to Trypeta work.

The larvæ, pupæ and flies were carefully compared with published descriptions and corrections made. For microscopical examination many slides were mounted, of the eggs, abdomens of females and males, the ovipositor, male genitalia, wings of the flies, feeding apparatus of the larvæ, the larvæ entire, and por-

tions of the apple peel showing larvæ exit holes and the punctures of the ovipositor.

To illustrate this Report photographs and measurement drawings were made. From the photographs some outlines were obtained for pen and crayon stipple drawings. These drawings are found in their proper places. Methods of capturing the flies, and also experiments with insecticides were tried. Incidentally the presence of other apple insects was recorded.

Work in Progress.

We are still at work upon the following questions: Will early formed pupæ transform earlier in the spring? Early and late maggots have been allowed to transform and the time the flies emerge will be noted. What depth of earth will prevent the flies appearing? Pupæ have been put at various depths in sand and the greatest depth from which they emerge will be recorded. Will pupæe found in barrels and bins in cellars transform? Pupæ, uncovered with earth, have been placed in open vessels and will be examined for flies.

TABULATED RECORD OF WORK, 1888.

Number.	Apples examined.	Variety.	Locality.	From whom obtained.	Date examined. mo.	Date examined. day	Trypeta entrance holes.	Trypeta larvae seen.	Size of Trypeta larva in fraction of inches.	Trypeta with Codling Moth.	Codling Moth.	Plum weavel punctures.	Effective plum weavel punctures.	Ash Gray Pinion.	Miscellaneous unknown.	Perfect fruit	Affected fruit.	Remarks.
1	9	Benoni	Manchester	Charles S. Pope	7	5					6	3		2	1	4	5	Fruit ¾ inch.
2	12	"	"	"	7	9					2					10	2	
3	12	"	"	"	7	14					4	2				10	2	Egg of plum weavel found, oval, white .07 in. x .043 in.
4	10	"	"	"	7	17					2	2				8	2	Egg found.
5	12	"	"	"	7	24					1	1	1			10		
6	5	Greening	New Gloucester	W. H. Jordan	7	30					8	3				2	3	
7	5	Nod-head	"	"	7	30				2	13	11			1	1	4	Badly affected, four plum weavel larvae and a codling moth in same fruit.
8	6	King of Tompkins	"	"	7	30				1	13	9			2	2	4	
9	6	New York Sweeting	"	"	7	30				4	4	4				1	5	Three codling moths in one fruit.
10	6	Gravenstein	"	"	7	30					14	10	1				6	Badly affected.
11	6	Early Harvest	"	"	7	30				5	2	1	2			2	4	Codling moths, 1 stem and 2 blow end.
12	5	Baldwins	"	"	7	30				2	6	2				2	3	Codling moth larva full grown.
13	6	Cat-head	"	"	7	30				1	11	6			2	1	5	Two plum weavel larvae dead.
14	6	Bellflower	"	"	7	30				2	6	2				2	4	
15	6	Benoni	"	J. W. True	7	30					7	7		2			6	Windfalls.
16	8	"	"	"	7	30					11	3				1	7	From tree.
17	6	Franklin Sweet	North Greene	Z. A. Gilbert	8	2				3						3	3	
18	11	Benoni	New Gloucester	J. W. True	8	6	4	4	.03					2		5	6	First trypeta larva found.
19	6	"	Manchester	Charles S Pope	8	10					3	16						Codling moth left fruit.
20	12	"	New Gloucester	J. W. True	8	14	48	5	.06 to .1	1	4						12	The most of this lot laid aside to transform.
21	6	Red Astracan	Manchester	Charles S. Pope	8	18					3	10	2			2	4	Codling moth full grown, two in one apple, one in cheek.
22	11	Benoni	New Gloucester	J. W. True	8	21	125	7	.11		2						11	Trypeta punctures mostly on pale cheek.

23	4	Franklin Sweet	Manchester	Charles S. Pope	8	23	9	2	.68		2						4		
24	3	Tetofsky	Farmington	D. H. Knowlton	8	24	Many	2	.25	1	2	1	1	1			3		First full grown Trypeta.
25	12	Red Astracan	Manchester	Charles S. Pope	8	28	"	17	.25	1	1					2	10		Entrance holes numerous. Three Trypeta larva in one fruit.
26	6	King Sweet	"	"	8	31	"	21	.25								6		Exit holes first observed. Seven Trypeta in one fruit.
27	6	Fameuse	"	"	8	31	15	10	.08 to .15								6		
28	6	Munson Sweet	"	"	8	31	80	14	.25								6		Two of these laid aside to transform.
29	7	Diana	"	"	8	31	67	20	.13 to .25	5	5						7		Exit holes of Trypeta.
30	6	Summer Sweet	"	"	9	6	15	7	.03 to .13	3	3						6		Larvae just hatched 1-16, ¼, ½, grown.
31	2	Benoni, (windfalls)	New Gloucester	J. W. True	9	12	Many	25	.25	2	2						20		Pupa found in fruit. 10 apples with exit holes and no larvae. 9 pupae in the box.
32	10	Benoni, (trees)	"	"	9	6	"	19	.25										6 in one fruit, one larva, one half grown.
33	23	Benoni, (trees)	"	"	9	20	"	52									23		This lot laid aside Sept. 6th. 52 pupae in box Sept. 20th, and fruit not greatly changed.
34	12	Red Astracan	"	"	9	7		1	.25		1	6					7		Entrance punctures in only one.
35	5	N. Y. Sweets	"	"	9	7	"	16									5		These all showed exit holes.
36	6	Sops of Wine	"	"	9	7	"										3		
37	2	Sweet Unknown	Oxford Co., S. Fair Exh't	D. H. Knowlton	9	15	"	3	.13								2		Larvae 1-4, 1-2, and full grown.
38	1	Unknown Tart	" "	"	9	15	"	5	.06 to .25								1		
39	1	Red Striped Sweet Unknown	Lincoln County	"	9	15	"	2	.25								1		
40	1	King Sweet	"	"	9	15	"	3	.13								1		
41	2	N. Y. Sweet	"	"	9	15	"	1	.13								1		
42	2	Unknown	S. Androscoggin	"	9	15	"	4	.08								2		
43	1	N. Y. Sweet	Kennebec County	"	9	15	"	2	.08								2		
44	2	Unknown Red Tart	"	"	9	15		1	.06								1		
45	1	Red Astracan	"	"	9	15	"	3	.16								2		
46	1	King Sweet	"	"	9	15	"	3	.13 to .25								1		One-half and full grown.
47	1	Early Harvest	Franklin County	"	9	15		3	.25								1		
48	2	Winthrop Greening	"	"	9	15	"	8	.08							1			Badly rail-roaded. Two dead larvae. Surface riddled with punctures,
49	1	Fameuse	"	"	9	15	"	1	.06										
50	2	Early Harvest	Cumberland County	"	9	15	"	3	.08										
51	2	King Sweet	" "	"	9	15	"	4	.25										
52	6	High T. Sweeting	Manchester	Charles S. Pope	11	6	"	4	.16		1								Codlin moth only one-half grown, probably second brood.

DISCUSSION OF OBSERVATIONS.

LARVÆ.

How Do the Maggots Enter the Fruit.

Early in 1888 we noticed small punctures through the skin of apples and found they led to minute channels in the flesh. By carefully following these channels we found the larvæ of Trypeta. We also worked the other way, found the very young larvæ in the flesh, traced their route backward and in several instances was able to follow it to these characteristic openings. These openings were found to be distributed over all parts of the fruit; blossom and stem ends, and cheeks, but more abundantly on the cheeks, and more frequently on the pale or shaded side of the apples. All the flies observed ovipositing were in the shade at the time the eggs were laid. This is natural, as the skin on the shaded side would be softer. In highly colored apples these punctures are hard to detect. In light colored apples they can be plainly seen with the naked eye. They are not readily detected, except by practice, from the brownish rust spots naturally found on fruit. This is probably why they have not been before observed.

How Long Does It Take the Larvæ to Mature.

In 1888, in Benonies, we found maggots one-eighth grown (Aug. 6th.) They could not have been hatched more than a week or so, as they were so small and the channels short and near the surface. By the 14th they were found one-fourth grown. By the 21st they were one-half grown. By Sept. 12th they were found in abundance full grown, and had commenced to vacate the fruit. The above observations were made upon apples taken from the same tree.

In 1889, in Early Harvests, the minute larvæ but a short time hatched were observed about the 10th of July. The maggots left the fruit and entered the pupæ state by Aug. 10th. From the above, we conclude that under *favorable circumstances* they mature in from four to six weeks, and soon leave the fruit. Observations on several other lots in 1888-9 confirm the above conclusions.

Arrested Development of Larvæ.

In the fall of 1888 a lot of apples which had been on exhibit at the State Fair was received for examination. Though it was the middle of September, the larvæ were small and many of them dead. We learned that some of the apples had been kept in cold storage and all in cool places. We suspected arrested development. We had come to believe from the examination of many apples, that somehow the maturity of the larvæ and the ripening of the variety were somewhat coincident. Had noticed that the larvæ grow much faster as the fruit softens. To test the effect of cold storage, a *portion* of a lot of Early Harvests collected July 9th, 1889, were placed in an ordinary ice chest. The remainder of the same lot was kept in a box under ordinary conditions. They were first inspected August 10th, and the larvæ from those kept under ordinary conditions had emerged, and the pupæ were found in the box. None had emerged from those in the ice chest. Those in cold storage were cut and examined from time to time, the last being opened September 15th, and the larvæ were still in them.

In 1888 we found larvæ half grown November 6th. In 1889 Mr. Briggs found a half grown larva December 1st. We found one December 25th, half grown, in a King Tompkins. Mr. R. S. Sweetser showed a larva at the Pomological Society meeting at Norway, Febuary 4th, and sent the writer larvæ about February 15th. If the eggs in these cases were laid at the time of killing frosts, October 10th, then the eggs remained unhatched longer than the usual time, or the larvæ in some cases are from two to five months reaching maturity. Cold seems to check development. The larvæ grow faster as the fruit softens. May not the occurrence of Trypeta larvæ in late winter fruit be from eggs laid late in the fall, which from cold are tardily hatched and from the effects of cold and the hard ttssue of winter apples are a long time in reaching maturity? May not cold storage arrest the work of Trypeta larvæ in fruit and prevent its rapid deterioration?

Are Trypeta Larvæ Found in Windfalls?

The examination of numerous specimens taken from the ground has shown conclusively that the maggots are found abundantly in windfalls. We have never seen exit holes in apples hanging on the trees and believe that the maggots remain in the fruit until it drops or is gathered. The presence of the maggots seems to hasten the maturity and dropping of the fruit. Larvæ are found abundantly

in marketed fruit from Massachusetts, which shows, that the larvæ will remain a long time after the fruit is harvested. Any very young larvæ will remain in the decaying apples until they are a mass of corruption. We received a lot of windfalls from Mr. True, shipped about September 6th. They were not examined until September 12, when in twenty of them we found twenty-five full grown maggots and several pupæ in the box. Hanging fruit picked from the same tree at the same date was full of younger maggots. From twenty-three specimens put in a box, fifty-two pupæ had emerged by September 20th. This shows that the apples having the older larvæ matured and dropped earlier.

When do the Larvæ Begin to Leave the Fruit?

The larvæ begin to mature about the first of August, in the early varieties and soon leave the fruit and enter the pupæ state. They may be found of all ages, in the summer and early fall varieties during the summer and fall, and emerge when mature. The larvæ hatched from eggs laid late in the season may be stored with the fruit and emerge any time during the winter, or remain sometimes by arrested development in the fruit until February. Maggots may vacate fruit when the food supply is abundant and it is occupied by younger larvæ of several ages. They leave the fruit through circular openings a little larger than the maggot. Several of these are sometimes found in the same fruit.

Transformation of Larvæ.

In 1888, August 8th, we found the first Trypeta larva about one-third grown in Benonies and laid some of the apples aside in a box over sand and left the larvæ to enter the ground. From time to time through August, September and October we laid others aside, but did not keep the lots separate, not then thinking that the early larvæ might transform earlier in the spring. The jars and boxes were kept in a room where there was a fire most of the time and where it did not freeze. The sand was somewhat moist when put in the boxes but as gauze was put over them the moisture soon evaporated so the sand was practically dry. About the first of May we moistened the sand in some of the jars and left it dry in others. Two or three lots of pupæ were left in jars and not covered with sand but not one fly came from these. In 1889, August 10th, we put some pupæ in a box without sand and examined them December 1st and all were dead. One box was

examined to see how deep the larvæ had burrowed to transform, and fourteen pupæ were found from one-half to one inch below the surface in loose sand. One or two were noticed to transform at the surface under decayed fruit. A few were also found in the shriveled fruit in the pupæ state. The flies began to emerge first from the jars which had been moistened. Below is a record of the time of appearance of the flies.

Date.	No.	Wet sand.	Dry sand.	Date.	No.	Wet sand.	Dry sand.
May 23....	2	+		June 25	3		+
June 4....	1	+		" 27	3	+	
" 7....	3	+		" 27	1		+
" 15....	4	+		July 4	2		+
" 19....	2	+		" 4	2	+	
" 20....	2		+	" 5	1		+
" 22....	5	+		" 7	2		+

The time of emergence covered about six weeks. The flies were at once transferred to a large box with a glass top in which fresh apple leaves were kept and apples with fresh cut surface. Some syrup made from white sugar was put in occasionally and they ate of it greedily. The flies appeared very quiet and often remained for a long time in the same place on a leaf, the side of the cage or upon the cut surface of the fruit. None of them lived over three weeks. None were noticed copulating.

Where do the Larvæ go to Transform?

The depth to which they go in the ground to transform was determined by putting infested apples in boxes over loose sand, and examining later for the pupæ. Our observations confirm those of Comstock and Cook, that, under the most favorable circumstances, they do not burrow over an inch. The larvæ, being footless and weak, have but little power to penetrate hard soil, and hence find the most favorable places for development in sandy locations. In orchards kept in sod, they do not find favorable circumstances for burrowing and undoubtedly enter the pupa state about the grass roots and are subjected to more mishaps. Even when they have loose sand to burrow in, they do not always enter the ground, as we have found pupæ on the surface of sand under decayed fruit. They are sometimes found in the fruit in the pupæ form during the summer months, and quite frequently in stored fruit. If infested fruit is left in a box, barrel or bin, the most of the larvæ will leave the fruit, and the pupæ will be found in the bottom of the receptacle.

Mr. Sweetser sent us a lot of Spitzenbergs and Hubbardstons in

December, 1889, and we found many exit holes, a few pupæ and occasionally a larva. We asked Mr. Sweetser to examine the barrels in which the apples were stored, and he sent us eighty pupæ.

Mr. Henry S. Smith of Monmouth, Me., says: "I swept up and burned large quantities of pupæ from where I stored Nodheads and Tolmans on the cellar floor. The apples had been in barrels until put up for market in December and January."

We have had a great many larvæ leave the apples and enter the pupa state in the bottom of the boxes and jars containing them.

Egg-Laying Habits of the Fly.

When do the flies lay their eggs?—The published views on this point are, that the eggs are not laid until late summer or mid-autumn. Comstock says: "According to my observations and all published accounts, the apple maggot does not occur in the apple until the latter part of the summer. "Lintner says: "During the latter part of the month (July) or in August it deposits several of its eggs upon an apple near the calyx end." Perkins says: "As the maggots do not eat the apples until well advanced toward maturity it is obvious that the eggs are not deposited on the fruit until the end of summer, and from that time to mid-autumn." Our observations do not warrant the above conclusions. The eggs begin to be laid in Maine, on the earlier varieties, by July 1st, and probably earlier in the states farther south. Oviposition continues until the flies die in the fall by killing frosts. We found numerous small Trypeta larvæ in Sweet Boughs and Early Harvests by July 9th. Comparing their size with newly hatched larvæ they must have been a few days old. Allowing for the time required to hatch it would make the time of egg laying July 1st or earlier. Larvæ found in early imported fruit from Massachusetts were more mature than in the above, which would mean earlier egg laying in Massachusetts.

They are found in abundance in half grown apples. The channels made by the *young* larvæ are largely healed by the growing tissue and might lead to the view that "they do not eat the apples until well advanced toward maturity." They are there, nevertheless, ready to rapidly grow when the pulp softens. As the fruit matures, the channels no longer heal, and being larger, become apparent. The close observer will find plenty of larvæ before the large yellow channels made by the adult can be seen. We had pupæ in considerable numbers the last season by August 10th. The fact that maggots of all sizes can be found from early in July until cold

weather shows that oviposition continues through the season. This is confirmed by an examination of females taken about the middle of September. In them were found plenty of mature eggs and others in varying stages of development.

Eggs and Reproductive System.

Discovery of the eggs in the apple, and also in the ovary of the female, completes our knowledge of the life changes of Trypeta. The researches of 1888 made us familiar with the entrance punctures. These were again found in the first lot of apples examined early in July, 1889. The first puncture examined contained one egg inserted vertically beneath the skin, and entirely concealed in yellowish, withered tissue. It was described and figured. The second apple revealed another egg, which was photographed. A third egg was transferred to a live box in apple juice and watched. In about fifteen minutes a motion was observed in the end opposite the pedicil. Soon the shell burst irregularly, the head of the larva protuded, and in less than a minute it had crawled out. A careful examination under high power proved it to be the larva of Trypeta. We went to Cumberland Centre the next day to study the insect at home. Caught several pairs copulating, and made a careful microscopical examination of the reproductive system. Found eggs in great numbers, which agreed exactly with those found in the apples During the season hundreds of eggs were taken from the females and many temporary and a few permanent slides prepared and additional photographs made. We believe no one will dispute our claim to discovery of the eggs, as nothing has heretofore been written about them.

Nature of the Reproductive System.

We find no record of a histological examination of this part of the insect. The oviduct leading into the ovipositor is short and soon divides into two quite long convoluted tubes, one on each side, leading to the ovate ovaries, which nearly fill the abdominal cavity. Each half ovary contains about twenty-four chains of eggs, each chain having at least seven eggs attached together, in different stages of development, which would make the number of eggs at least 336. As many as eleven stages in the development of the eggs were observed. As many as seven stages were frequently seen attached and we are not prepared to say but what the loose forms seen in the reproductive passages were also detached

parts of the chains, which would increase the number of eggs to 528. Nor are we prepared to say but what the pear-shaped unsegmented body at the other end of the chain might develop still others. See Pl. II, Figs. 4-10. We actually counted forty-eight chains in several insects and each chain had at least seven eggs, which would make 336 eggs as the minimum number. The chains of eggs were mounted and drawn to scale and are shown (Plate II, Figures 4-10.) The developmental stages of the eggs show conclusively that oviposition is necessarily extended over considerable time.

Discovery of the Ovipositor as a sharp instrument, fully capable of making a puncture through the skin of an apple, is a very important observation. The ovipositor has been described as truncate and blunt by Loew, Lintner and Perkins and incapable of making a puncture. All references to the ovipositor we have seen undoubtedly refer to the last abdominal segment, the ovipositor and sheath retracted within it apparently never having been seen. The ovipositor is shown (Plate II, Figures 1 and 3) to be a sharp instrument fully capable of making an incision. Out of over fifty flies only a few died with the ovipositor extended, and in cabinet specimens it is usually retracted within the sheath. We have several slides showing the ovipositor extended, also cabinet specimens showing it finely. Some may claim this discovery for Walsh, as he says the insect oviposits through the skin of the apple, but he examined apparently only one female, and we doubt his having seen the ovipositor. Most eminent Entomologists since Walsh have doubted the insertion of the egg, never having described or figured the ovipositor, therefore, credit should be given to the one who first describes and figures the instrument and observes it do its work.

Confirmation of Walsh's statement, that *the female punctures the apple to lay her eggs* is exceedingly interesting, for as Prof. Riley writes us, "It is opposed to everything which we know regarding the egg laying habits of *Diptera*." This has been denied by all prominent Entomologists since Walsh's time. By witnessing the oviposition; finding the eggs in the characteristic punctures; observing one hatch and proving it to be Trypeta, and by finding the same eggs in the ovary of the female that we found inserted beneath the skin of apples, the position of Walsh is sustained. By means of a jeweler's glass on the eye we witnessed the process of oviposition several times. The fly would run about over the apple nervously for a short time as though selecting a suitable place, then coming to rest, elevated the thorax behind and turned the abdomen

nearly at right angles to the thorax. The legs were spread out as though to brace the insect. The sharp, brownish ovipositor was then plainly protruded, and by repeated vertical motions inserted into the apple. So far as we could see, the ovipositor pierced the skin the first plunge and the continued probing was to enlarge the hole. We could not see the egg escape, as the opening to the oviduct was concealed below the skin of the apple. The process occupied a half minute or so. In all the cases we observed, the insect oviposited in the shade. The puncture cannot be easily seen at first, but soon the adjacent tissue changes to brown and shrivels, showing the opening plainly with a brownish areola around it. We marked around one puncture as soon as it was made and examined it five days later, finding the shell of the deserted egg and in a channel close by leading to it the young larva.

Relation of Trypeta to Other Insects.

The published views on this question are: (*a*) That the eggs are deposited directly in holes made by other insects; (*b*) That they are deposited on the surface of the apple near the calyx end, the hatched larvæ entering the holes made by other insects, especially those of the codling moth; (*c*) There is an implied view expressed by Prof. Perkins that they are deposited on the outside, hatch there, and the young larvæ early bore through the peel and enter the fruit. Hundreds of apples have been found infested by Trypeta with no evidence of codling moth work or the work of any other insects, and no external openings, excepting the small punctures made by the Trypeta fly. The finding of Trypeta eggs beneath the peel of apples in these characteristic punctures, settles the question beyond dispute, and warrants the conclusion that *the work of Trypeta is entirely independent of other insects.* This is important, for there was a hope that the destruction of the codling moth would check this pest by destroying its means of entering the fruit.

Insects Sometimes Mistaken for Trypeta.

The term *apple worm* is often vaguely applied to any sort of larva infesting the apple. The name *apple maggot* is frequently incorrectly given to the true apple worm, the caterpillar of the codling moth. While in some parts of the country the true apple maggot, the larva of Trypeta pomonella, is called the "*railroad worm.*" The larva of the codling moth is usually in Maine

correctly called the apple worm, but sometimes it is confounded with the apple maggot. The term maggot is restricted by Entomologists to footless larvæ of two-winged flies. The larvæ of the codling moth have legs and spin cocoons and are correctly called caterpillars.

There should be no trouble in distinguishing the apple maggot and its work, from the codling moth and its injuries. The apple maggot or "railroad worm" tunnels the pulp of the fruit, filling it with brownish channels, while the codling moth caterpillar usually enters the calyx, works about the core and finally leaves the fruit through a direct channel from the core to the cheek.

Apple worms spin cocoons, which are placed under the loose bark of trees or elsewhere *above ground* and from which moths ("millers") come forth. Apple maggots go into the ground to spend the winter and from their pupæ two-winged flies, (described below) and related to the house fly, mosquitoes, and crane flies, come forth. The apple worm is larger and has sixteen legs, a broad black head with a black patch behind it, and is usually pinkish in color. The apple maggot is smaller, footless, tapering to a small head, and greenish white or slightly yellowish in color.

The apple maggot deposits its eggs in the fruit while on the trees and is found in the hanging, stored and marketed fruit, and in the windfalls. In apple pomace and decayed fruits, other maggots are frequently found in great numbers. These are generally the larvæ of *pomace flies*, which work in apple and other fruit refuse and do no injury. We have never seen or heard of *Trypeta flies* laying their eggs in apple refuse, and any worms found in such material may be considered as the larvæ of other insects. These pomace flies are plentiful in Maine about decaying apples, apple pomace, crushed fruit, vinegar barrels and apple driers, and are often a nuisance. We took three species of pomace flies about apple trees in Cumberland county early in July, the two species considered by Prof. Comstock (U. S. Agr'l Rept., 1881–2, p. 198) and another undetermined species. The flies are smaller than Trypeta, light brown or yellowish, and have clear wings and red eyes. The pupæ and maggots are smaller and more slender than those of Trypeta. The maggots change to the pupa state within or about the decaying fruit. We have taken more than a hundred pupæ from a single decayed apple, and from a single apple have bred nearly a hundred of the vine-loving pomace flies. Their time of

transformation is short. Many broods appear in a season. That the pomace flies may be readily distinguished, we give (Plate IV) a copy of Mrs. A. B. Comstock's excellent drawings, taken from United States Agricultural Report, 1881–2, Plate XVI. For a more detailed account of the pomace flies the reader is referred to the above named Report, p. 198.

VARIETIES KNOWN TO BE AFFECTED BY TRYPETA POMONELLA,

Variety.	Flavor.			Time of Maturity.	Remarks.
	Sweet.	Sub-acid.	Acid.		
Alexander			+	Autumn	Sparingly infested.
American Golden Russett				Winter	" "
Bailey Sweet	+			"	" "
Baldwin			+	"	" "
Benoni		+		Autumn	Badly "
Canada Baldwin			+	Winter	Sparingly "
Cat-head		+		Autumn	" "
Colvert		+		"	" "
Danver's W. Sweet	+			Winter	" "
Derby Pippin		+		"	" "
Diana		+		Autumn	" "
Duchess of Oldenburgh			+	"	" "
Early Harvest		+		"	Badly "
Esopus Spitzenburgh		+		Winter	" "
Fall Jenneting		+		Autumn	" "
Fall Pippin		+		"	Sparingly "
Fameuse		+		Winter	" "
Franklin Sweet	+			Autumn	Badly "
Garden Royal		+		"	" "
Golden Ball		+		Winter	Sparingly "
Golden Russett		+		"	" "
Golden Sweet	+			Autumn	" "
Gravenstein		+		"	Badly "
Greening R. I.			+	Winter	Sparingly "
Grime's Gold Pippin		+		"	" "
Haley		+			" "
High Topped Sweeting	+			Autumn	Badly "
Hubbardston None-such		+		Winter	Sparingly "
Hurlbut		+		Autumn	Badly "
Irish Peach		+		"	Sparingly "
King Sweet	+			Summer	Badly "
King Tompkins Co		+		Winter	Sparingly "
Lady's Sweet	+			"	" "
Maiden Blush	+			Autumn	" "
Mexico	+			"	" "
Mother		+		Winter	Badly "
Munson's Sweet	+			Summer	" "
New York Sweet	+			"	" "

VARIETIES KNOWN TO BE AFFECTED BY TRYPETA POMONELLA.
(*Continued.*)

Variety.	Flavor.			Time of Maturity.	Remarks.	
	Sweet.	Sub-acid.	Acid.			
Nodheads		+		Winter	Badly	infested.
Northern Spy		+		"	"	"
Paradise Sweet	+			"	"	"
Pearmain		+		"	Sparingly	"
Penankee		+		"	"	"
Porter		+		Autumn	Badly	"
Pound Sweet	+			Winter	Sparingly	"
Primate		+		Summer	"	"
Pumpkin Sweet	+			Autumn	Badly	"
Ramsdell's Sweet	+			Winter	Sparingly	"
Red Astrachan		+		Summer	Badly	"
Ribston Pippin			+	Winter	Sparingly	"
Rolfe		+		"	"	"
Russell		+			Badly	"
Sherwood's Favorite		+		Autumn	"	"
Snow		+		"	"	"
Somerset		+		"	Sparingly	"
Sops of Wine		+		Summer	Badly	"
Sweet, or Yellow Bough	+			"	"	"
Tetofsky	+			"	"	"
Tallman Sweet	+			Winter	"	"
Twenty Ounce		+		Autumn		
Wagner		+		Winter		
Wealthy		+		"	"	"
Westfield's Seek-no-further		+		"		
William's Favorite		+		Summer	"	"
Winthrop Greening			+	Autumn	"	"
Yellow Bellflower		+		Winter	"	"

REMARKS.

No pains have been taken to make an exhaustive list of apples affected by *Trypeta*, but in pursuance of work upon this insect, the writer has found it in most of the varieties named. The list has been extended by several members of the Pomological Society. Probably other varieties grown in the State are infested. The list is full enough to convince any one that Trypeta works in a wide range of varieties, and is not fastidious, but gratifies sweet, sub-acid and acid tastes and indulges in summer, autumn and winter fruits. Varieties sparingly or not at all affected in some parts of the State are badly infested in other places. In the table, the terms sparingly or badly infested, refer to the writer's knowledge of the frequency of Trypeta in the State and will of course not be correct for any given locality.

Spread of Trypeta from Variety to Variety.

Trypeta has been in the orchard of Hon. Samuel Libby, of Orono for the last three years at least, but has confined its depredations to a single Benoni tree. They are not scarce on that tree as the writer has taken as many as three larvæ from a single apple. Within twenty-five feet is a Wealthy, fifty feet a Red Astrachan and sixty feet a Nodhead, all varieties badly infested in other other orchards in the State, but not a single maggot has been detected in any of them.

The same is true in Mr. Webster's orchard on the other side of the river, where Trypeta has for several years feasted on Golden Russetts while several other varieties equally inviting have been exempt. Last season the Golden Russett did not bear and the fly transferred its depredations to another variety near by. Within 100 rods of Mr. Webster's orchard, across the river from it, is another orchard where early sweet and sub-acid varieties are grown, yet Trypeta has not been detected.

Mr. Atkins says: "That in Bucksport some trees of a variety will be infested while other trees of the same variety in the same orchard are exempt."

The slowness with which this pest spreads from tree to tree, and variety to variety in an orchard, and from orchard to orchard, has been noticed by Comstock and others, and when any attempt has been made to explain it, it has been by saying the insect is *fastidious* in its tastes. It is probably true, taking the whole State or country, that the pest is worse upon summer sweet and sub-acid varieties, but it does not confine itself to these. The long list of varieties we publish, which are infested, shows a wide range of occurrence in sweet, sub-acid and acid, summer, autumn and winter fruits. The history of this insect in Maine shows that it was first introduced from adjoining states in early imported fruit. It has gradually spread from the early varieties until neither sweet, acid, sub-acid, early or late apples are exempt from its attacks.

The larvæ from early apples enter the pupa state earlier and emerge earlier in the spring, or from the earlier apples there would be generated an early race of flies. These would appear under ordinary circumstances when the early apples were ready to receive the eggs, and before other varieties were far enough advanced, and the early apples would continue to be infested from year to

year. If the early apples did not bear, or from arrested or accelerated development the flies appeared earlier or later than their accustomed variety, they would be forced to find a new nidus for their eggs. Let us suppose this to be a later variety; then, as this variety matures later, the larvæ would enter the pupa state later, and appear the following spring a later race of flies. Our observations show that the flies are on the wing from early July until frosts; that the flies continue to emerge for a long time, or that there are several races of flies appearing at different times. A mild winter might force the late pupæ and convert them again into an early race, which will explain the disappearance of larvæ from a later variety and their appearance in an earlier variety.

In some orchards the flies appear later and affect the later varieties worse than the earlier. This may be because the later fruits were first affected and the flies have continued in them, or the location of the trees or the nature of the soil may give unfavorable conditions for early development. The above facts illustrate the erratic habits and wonderful adaptibility of Trypeta, and must impress us with the fact that we have a formidable pest with which to contend.

We believe that each tree usually produces the flies that infest it. The flies were thick early in July on Early Harvests, but at that time none were found about the trees of later varieties. Later in the season the fruits of the fall and winter varieties became infested. The Trypeta fly is not adventurous, does not roam about to gratify the requirements of a fastidious appetite, nor does it stay so closely at home because it is over particular about what it eats. It is rather easily pleased, contented with what is set before it, be it *wild haws or Early Harvests*. It clings from year to year to the variety chance has thrown in its way, and does not abandon it, until by over-increase or want of bearing, it is forced to find another nidus for its eggs.

In Illinois though common in wild haws it has not until recently spread to cultivated fruit. It probably left the haws in the East because in the settlement of the country the wild haws were cut. In Michigan it has been forced to infest wild plums and cherries. These things do not show fastidiousness but adaptability in a wonderful degree. Certainly an insect contented in wild haws would revel in any kind of a cultivated apple. The fact that the pest has spread in our orchards slowly to apples of all flavors and times of maturity shows an alarming power of adaptation to new food

and surroundings. It shows that if deprived of the softer and earlier varieties it is still equal to the emergency. Adaptable, contented, the perfect embodiment of the sentiment "be it ever so humble there is no place like home."

General Description.

Perfect insect a two-winged fly somewhat smaller than the house-fly. Readily recognized by its general black color; yellowish head and legs; dark feet; greenish, prominent eyes; white spot on the back and upper part of the thorax; three white bands across the abdomen of the male and four across the abdomen of the female, and four black bands across the wings, resembling the outlines of a turkey. (See plate I, figures 1 and 2.)

Technical Description.

Perfect insect (female)—Maximum length, 6.2 mm. (.245 in.); minimum length, 5 mm. (.205 in.); average length of ten specimens, 5.8 mm. (.228 in.) Maximum spread of wing, 12.5 mm. (.5 in.); minimum, 10.8 mm. (.43 in); average of five, 12.15 mm. (48 in.)

Head—Light brown or pale rusty red; space between the eyes in front and the antennæ, darker; front of the face and hind orbit of the eye more or less tinged with white, the latter bearing a row of black bristles; antennæ, .5 mm. long; (.02 in.) three jointed; the first joint shortest; second joint having numerous short, thick, black bristles on the inner face; third joint as long as the other two, oblong, rounded at the end, flattened on the inner face, pubescent. Arista, dark brown, slender, more than twice the length of the joint; frontal bristles black. Mouth large, broader than long; palpi and proboscis pale yellow and pubescent. Eyes prominent, length 1 mm. to 1.25 mm. (.04 in to .05 in); breadth .45 to .50 mm. (.018 in. to .02 in.); green with reddish brown, greenish and steel blue reflections in life, but dull and greenish black in cabinet specimens.

Thorax—Maximum length 2.75 mm. (.11 in.); minimum length 2.25 mm. (.09 in.) Black. A white stripe on each side in front of the wing, involving its base and the humeral callosity. Thoracic dorsum with four narrow silvery or bluish gray longitudinal stripes arranged in pairs. The pairs separated by a median, broad, black space. Stripes of each

pair separated behind by a narrow, black line, confluent in front, the inner stripes shorter. Scutellum, elevated, flat, white above with black sides and base. Bristles of the thorax and scutellum black. Balancers three jointed, outer joint black, prominent, irregularly triangular, basal joints brownish.

Abdomen a little longer than broad. Length, 2.22 to 2.3 mm. (.088 to .092 in.) without the ovipositor. Black, ovate, composed of seven segments. First and second segments rapidly widening. Second segment widest. Sixth segment abruptly narrowed, shorter than the fifth, and apparently rudimentary and represented below only by a narrow sternite. Seventh segment truncate at the end, when the sheath and ovipositor are retracted, but sloping into the sheath when it is protruded. Posterior portion of the second, third, fourth and fifth segments (occasionally the sixth) broadly banded with white.

Ovipositor—Length, 1.33 mm. (.053 in.); breadth .33 mm. (.0133 in.) at the middle where it enters the sheath, broadest at the base, tapering from where it leaves the sheath to a sharp point somewhat curved (usually upward) at the end. (See Plate II, Figure 1.) Brownish, hornlike, bearing a median groove below, which is covered by two flaps which extend half way from the sheath to the point. These flaps are covered by a shorter median one. From beneath the flaps the eggs escape. In specimens mounted in balsam the oviduct and ovipositor show within the sheath to its base.

Sheath of the ovipositor .67 mm. by .233 mm. (027 in. by .009 in.); oblong, largest at the base, then narrowing, widening again in the middle, narrowing again and at the lower end widening into a terminal ring. Truncate at the end. Beautifully marked above and below by oblong tubercles arranged in about fifteen oblique rows, beginning at the base of the sheath and sloping backward each way from the median line above and below. The rows from above and below meet each way on the sides at an angle. A triangular space on the sides at the base and above not tuberculate. The tubercles become smaller and less conspicuous toward the sides. (See Plate II, Figure 1)

Legs about 3.75 mm. long (.15 in.) Femora and tibiæ about equal, 1.5 mm. (.06 in.) Tarsi shorter, .75 mm. (.03 in.) Femora black with yellowish distal and proximal ends. Front pair lighter, with hind sides more or less dark. Proximal joints of all the tarsi and tibiæ clay yellow. Distal joints of tarsi *all* clothed with dark

hairs, making the feet *all* more or less black. (See Plate I, Figures 1, 2 and 3.)

Wing—4.5 mm. to 5.5 mm. long (.18 in. to 22 in.,) 2 mm. to 2.5 mm. (.08 in. to .1 in.) broad, hyaline, traversed by four black cross bands. Base of the wing clear; first band beginning opposite the sinus of the basal lobe, sloping backward and joining the second band about the middle of the posterior margin. Second, third and fourth bands confluent in front and diverging backwards. The dark bands are arranged so as to resemble the outlines of a turkey, the band toward the body representing the neck and head, the second the body, the third the legs and the fourth the tail. The whole surface of the wing covered with minute hairs, those on the bands black, the others clear. Margin of the wing all around and the subcostal vein armed with bristles. (See Plate I, Figures 1-2.)

Perfect insect (*male*)—Same general color as the female but smaller; length 4 to 5 mm. (.16 to .2 in.); five instead of seven segments to the abdomen, second, third and fourth segments *only* banded with white. Wings shorter and narrower and not spreading so much behind when the fly is at rest; abdomen of the same general shape but smaller. (See Plate I, Figure 2.) Copulatory apparatus 3 mm. (.12 in.) long, yellowish brown; the penis coiled and with the auxiliary organs usually folded under the abdomen in a broadly oval cavity which extends forward to the middle of the fourth segment. The genitalia are shown Plate II, Figure 2. (*Notes.*—The eyes are sometimes variegated with brownish and greenish patches. The fifth abdominal segment is occasionally narrowly banded with white. Sometimes the white abdominal stripes in places involve the whole width of the segment. The coloring at the angle of meeting of the first and second proximal bands in the wings is quite variable, from hyaline through faint, dusky shades to black. The black bands are quite variable in brightness. They seem to be brighter in the males.)

Eggs—Length (.8 to .9 mm.,) (.032 to .036 in.); breadth (.2 to .25 mm.) (.008 to .009 in.); white in the oviducts, but light yellow when taken from the fruit; fusiform and about four times as long as wide; pedicelate at the end; pedicel about one-twentieth of the length of the egg, longer than broad and rounded at the end; pedicelate end broadest and abruptly sloping into the pedicel; other end more sloping. The shell of the egg at the pedi-

celate end, for one-fourth of the length, is pitted with irregular hexagonal cells, the borders of which are raised and lacerated, giving a roughened or spinose appearance to the surface; sculpture most prominent near the pedicel and gradually lost in the general surface which is smooth; the spinose portion is darker. The larva is placed in the egg with the head away from the pedicel and the end containing the head is inserted into the apple. Ovaries double and saccate, occupying most of the abdominal cavity; each side containing twenty-four chains of eggs, each chain at least seven eggs in different stages of development. Perfect eggs and stages of development are shown on Plate II, Figures 4-9.

Larva—Length, 7 to 8 mm. (.28 to .32 in.); breadth, 1.75 to 2 mm. (.07 to .08 in.) When full grown usually yellowish white. When younger and sometimes when full grown tinged with greenish; footless; the body composed of fourteen segments. Ninth, tenth and eleventh segments widest, narrowing rapidly toward the head, which is small, pointed and emarginate. From the broadest segment the body slopes slowly backward to the last segment, which maintains its size one-third of its length, and then abruptly slopes to one-half its thickness. The lower and posterior half is nearly vertical behind, giving the larva a docked appearance. (See Plate I, Figure 3.) From the lower part of the first segment are protruded a pair of black, curved, parallel hooks, the *rasping organs*, by means of which the maggot tunnels the fruit. These hooks are attached to a black chitinous framework (see Plate III, Figures 1a and 1b), the crest of which shows plainly from above through the first three anterior segments and gives the impression of a black spot back of the head. To the unaided eye the hooks and chitinous framework appear as two small black spots headward. When the first three segments are retracted the head appears somewhat blunt, and the hooks do not show. On the dorsal surface on each side, at the union of the third and fourth segments, are two yellowish brown tubercles, the anterior openings of the breathing organs and called the *cephalic spiracles*. (See Plate III, 1a and 1b.) These tubercles can be seen by the unaided eye, but their structure cannot be determined. When magnified, they appear funnel-shaped with the border of the funnel expanded into a double row of about twenty cylindrical projections. At the base of the funnel is a short bulbous enlarge-

ment. Leading backward from each spiracle to the last segment of the body is a tube or air passage (trachea) which terminates on the sloping surface of the last segment, in a caudal spiracle. One of the caudal spiracles enlarged is shown Plate III, Figure 1c. At the junction of the fourth and fifth segments, and the junction of the next to the last and last segments, are branch tubes connecting the tracheæ.

Pupa—Length 4.2 to 5.2 mm. (.17 to .21 in.); breadth 2 to 2.6 mm. (.08 to .1 in.). Pale yellowish brown. When the maggot assumes the pupa state it does not shed the larval skin. The maggot contracts, assuming an oval form. The head segments are entirely retracted so that the tubercles of the cephalic spiracles project in front. The posterior end contracts but the caudal spiracles remain in view and the larval segments are easily made out. The true pupa is found within this shrunken larval skin, or in the language of the Entomologist the pupa is *coarctate*. The pupa is a little more than twice as long as wide and barrel shaped, the ends sloping about equally. The larva is about four times as long as wide and the head end is very sloping and pointed. The pupa is only twice as long as wide and nearly equally sloping at the ends. Otherwise the resemblance between the pupa and larva is apparent. There is quite a variation in the size of pupæ, some are much longer and thicker than others and may be of females, as the female flies are much larger than the males. (See Plate III, Figure 2.)

Life History.

In early seasons, under favorable conditions, the flies in Maine begin to emerge about July 1st, and earlier in the States farther South. They continue to emerge all summer and are on the wing in abundance until the middle or last of September and occasionally in October. Early frosts check them. The flies lived three weeks in confinement and will probably live longer in nature. They begin to deposit their eggs in the early fruit by July 1st or earlier, and egg laying continues while the flies are on the wing. The earlier races of flies affecting the earlier varieties, and the later races the fall and winter fruit. Each female is capable of laying, at least, between three and four hundred eggs, which are inserted from time to time, one in a place, by means of a sharp ovipositor through the skin of the apple. The eggs being successively developed in the ovary of

the female, after the manner of the eggs of the barn-yard fowl, the season of egg laying extends over considerable time. The eggs are vertically inserted into the pulp of the apple, with the end opposite the pedicel, which contains the head of the maggot, pointing toward the core. The eggs are deposited in all parts of the apple, usually upon the cheeks, sparingly near the calyx and stem ends, and more abundantly upon the pale or shaded side of the fruit. The time required to deposit the eggs is about one-half minute. By means of the sharp ovipositor a characteristic puncture, .33 mm. (.0133 in.) diameter, is made through the skin of the apple. These punctures can be detected by careful observations with the naked eye, but a pocket lens is necessary to see them well. They appear as brownish specks, and have not been before distinguished from the brownish, rusty spots common on apples. Under the glass they appear as circular or oblong openings, surrounded by a brownish border, somewhat shrunken by the shriveling of the tissue beneath. They may be numerous on the same apple. The eggs hatch in four or five days under favorable conditions and the minute larvæ begin at once to work in the pulp of the apple. They have no true opposable jaws, but the head is provided with two black curved hooks, situated above the mouth, with which they rasp the pulp of the fruit rapidly by means of a vertical movement of the head. They live upon the juice of the particles of apple thus detached which is sucked into the mouth. The pulp is rejected and turns brown. They can burrow their length in soft fruit in less than a minute. The channels made by the young larvæ, while the fruit is still growing, are largely healed and neither they nor the minute white larvæ are liable to be detected by the naked eye or by the casual observer. As the larvæ grow and the fruit matures, the enlarged channels do not heal, but turn brown and the presence of the maggots is then readily detected. These channels meander through the whole fruit even the core. They often cross each other, enlarge as the larvæ grow, and in the last stages of Trypeta work run together, producing large cavities. Finally they involve the whole fruit, rendering it a worthless mass of disgusting corruption, held together by the peel.

In the early stages of Trypeta work there is no external evidence that the fruit is infested, excepting the punctures made for the insertion of the eggs. By these punctures the presence of the maggots can be detected. In advanced Trypeta work, brownish trails, where the larvæ have come to the surface, can be seen

through the skin. Apples marketed with no suspicion of their being infested are frequently found hopelessly involved, honeycombed, and worthless. Apples apparently sound when gathered, may by the presence of eggs or young larvæ, afterwards become hopelessly involved. The newly hatched larvæ are a little shorter than the egg and could not be readily detected in the white pulp of the apple without a pocket lens. They attain their growth, under favorable circumstances, in four or five weeks, but their development may be arrested by cold, insufficient food, hardness of the fruit, &c., for a great length of time. They remain ordinarily in the fruit but a short time after they are mature. They often leave it and go into the pupa state when there is an abundance of nourishment and the fruit is still occupied by younger larvæ of various ages. If the fruit is kept cold, though full grown, the larvæ remain longer or may even change to the pupa state within it. We have never see the exit holes in hanging fruit and believe the maggots do not drop, but go into the ground from the fallen fruit. Their presence causes the fruit to mature earlier. Fruit picked from the trees may contain larvæ and often stored or marketed fruit is alive with maggots. The exit openings are characteristic, irregular holes about 2 mm. (.08 in.) in diameter surrounded by a brownish border. They look as though the maggots had gnawed a hole for the head, and then forced the body through, leaving a lacerated border. They may occur anywhere on the apple but are more frequently found where the brown larvæ trails show through the skin. They begin to appear in the early apples about the first of August and may be found until frost in windfalls and in the stored fruit as long as the larvæ remain.

It would seem that the development of the larvæ is so nicely timed that they are not mature until the fruit is ripe. Their development is slower in late and hard fruits. A dozen maggots may infest the same apple though a single one is enough to render it worthless. The maggots have been found in numerous varieties, early and late; sweet, acid and sub-acid, extending from early in July through August, September, October, November, December, January and February. The larvæ usually leave the apples and go into the ground an inch or less and soon change to the pupæ state. The pupæ are occasionally found within the fruit in windfalls and quite frequently in stored fruit. Sometimes the larvæ change on the surface of the ground under decaying fruit. On grass ground they probably change in the debris about grass roots.

In the bottom of boxes, bins and barrels where infested fruit is stored, pupæ may be found in abundance.

Our observations show that if the pupæ are kept in a warm room in a box or bottle, and not covered with earth, they will not hatch. In the cellar and cool store-rooms, where apples are usually kept, it may be different. The pupæ remain in the ground a greater or less length of time, depending on when they enter the pupæ state, soil, location and season. They can be forced by favorable or retarded by unfavorable circumstances in the laboratory, and this is probably true in nature. Specimens kept by Professor Comstock in a warm room all winter, began to emerge May 28th, and continued to appear until July 6th. (He does not say when they entered the ground.) The specimens we transformed, entered the ground in August, September and October; and came forth as flies from May 23d until July 7th, or they finished appearing about the time the first ones appear in nature. This shows forcing. Dr. Goding records the remarkable instance where late larvæ found in fruit in January went into the pupæ state and appeared by Febuary 1st. This would indicate that the later larvæ appear earlier, which is contrary to our experience. Possibly it may be unusually rapid transformation due to forcing. The appearance of the flies again the following summer completes the life history.

Remedies.

Trypeta is an unusually hard insect to destroy. The eggs are laid under the skin of the apple; the larvæ spend their time in the fruit and the pupæ are safely concealed in the ground, within the shrunken skin of the larvæ, therefore, they are well protected from destructive parasites and none are known to infest them. The flies do not seem to be enticed by sweetened poisonous substances and cannot to any extent be trapped. The eggs are so safely lodged in the apple beyond the reach of poisons applied by spraying, that there is no hope in that direction. The only chances left are to destroy the larvæ and pupæ. The larvæ are found abundantly in windfalls, and the pupæ in bins and barrels where fruit has been stored. *Destroying windfalls would prevent the maggots going into the ground, and burning refuse from bins and barrels would dispose of those in stored fruit. These methods are practical, easily applied and should be rigidly enforced.*

There are some *hopeful* and *helpful* features in our struggle with

this pest. The history of its work in other states shows that its ravages have natural limits. Though bad enough, it has not apparently gone on from bad to worse, but has kept within certain bounds. Flies as a class are delicate insects and are liable to many mishaps and great variation in abundance from year to year. Trypeta seems to be confined largely to sheltered locations and sandy soil, and does not from its nature spread rapidly from tree to tree, variety to variety, orchard to orchard.

To *discourage* us is the fact that a new supply of the pest is yearly brought into the State in imported fruit and every railroad town is liable to become a generative center for the pest. Again, unscrupulous orchardists at home, to save loss, knowingly market infested domestic fruit. Infested fruit may be marketed without knowing it. In both cases it is apt to be dumped on the ground and spread the pest. The sale of fruit from one part of the State to another is liable to hasten the spread of the flies.

All things considered, we firmly believe the ravages of this insect can be controlled, if we avail ourselves of the known means to check it. Below is a detailed consideration of useless, preventive and direct methods of coping with the pest.

Useless Methods.

1. Spraying early in the season when the apples are small would do no good, as the flies are not on the wing until July, when the early fruit is fully half or two-thirds grown, and too large too spray with safety. Spraying, even if safe, would do no good as the eggs are inserted under the peel, and the young larvæ in them being protected by a shell are beyond the reach of poisons. The apparent decrease of Trypeta after spraying, mentioned by Mr. Augur in Pomological Society Report, 1887, page 101, must be accounted for by another and independent cause.

2. In confinement the flies are very fond of sugar, yet about the trees, where other flies of several species were regaling themselves on apple juice, we did not see a single Trypeta fly feeding. Sweets poisoned with arsenious acid and corrosive sublimate, and placed on paper in shallow pans in the trees failed to attract them.

3. Sticky fly papers seem to be useless. We exposed several sheets in the branches of a tree where the flies were thick, for three days, and only took a *single* Trypeta fly.

4. It has been suggested "that a practical way to defeat the

work of this insect in great measure is to raise little early fruit." We have no confidence in this method. It is not a remedy. What fruit growers want is a way to check the pest and save them the invaluable luxury of early fruits. Would it not be much better to save the trees and for two years carefully destroy the windfalls and with them the pest? Those who first suggested this method believed the pest confined its ravages to the early fruits. To cut down the early fruit trees would not destroy Trypeta. Experience of Maine fruit growers, and our own observations, show conclusively, that the insect works badly in late and winter fruit, and is known to infest most of the varieties grown in the State. If deprived of the early varieties, a want of food supply would make it worse in the later fruits. We believe that cutting down our fruit trees would "defeat the ends of this insect," but what the profit if in our revenge upon it we at the same time sacrifice our fruit. There is no lazy way to check Trypeta. It will have to be done by a direct, squarely fought battle. We firmly believe we have in the careful destruction of the windfalls the means of destroying the pest.

The Trypeta is not like la grippe, spreading over a State in a day, but it goes slowly from tree to tree, variety to variety, orchard to orchard. The checking of the pest then is largely an individual matter, to be worked out independently in each orchard. We sincerely hope the fruit growers of Maine will give the destruction of the windfalls and the disposal of refuse from apple barrels and bins a fair trial, before passing these methods idly by as "impracticable to any extent."

8. The destruction of our early fruit trees, excepting a few to be left as traps, has been suggested. This method is based upon the erroneous belief that Trypeta works only in early fruits. If we raised no early fruit the early flies would do no harm. The destruction of the larvæ from these trap trees would not lessen the ravages of the later appearing races of flies upon late fruits. Destroying the early fruit would force many of the early appearing flies to find a nidus for their eggs in the later fruit; thus increasing the number of later flies.

Preventive Measures.

1. Keep the orchards in grass and in the fall or spring burn under the trees to destroy the pupæ that are about the grass roots. The experience of fruit growers so far as we know, is to the

effect, that orchards in grass are less affected This is reasonable, because the maggots are weak and cannot enter the ground under such conditions and would be forced to remain above ground about the roots and would be more subject to mishaps. Burning the grass would certainly destroy many.

2. If the orchard is in cultivation, deep spading or plowing in the fall or spring would probably destroy them. The maggots go into the ground less than an inch. The flies are weak and could not reach the surface from any great depth. Stirring the surface of the ground in the spring to expose the pupæ to birds and other predaceous animals has been suggested by Prof. Riley. The above remedies are based upon the supposition that the maggots have been allowed to go into the ground. If the windfalls have been gathered carefully as they should be none would be left to enter the ground, and these preventive measures useless.

3. Orchards on sandy soil and in sheltered places with a southern exposure are worse affected. In planting orchards such conditions might be avoided.

4. Prof. Riley in Amer. Agric., July, 1872, suggested "covering the ground thickly with salt, ashes, lime or other substances" to prevent the maggots appearing, but we do not know that these applications have been tried.

5. Prevent by legal enactment the importation of foreign fruit from localities known to be infested. The pest was undoubtedly introduced into the State by importation of apples, and each year there is a new invoice from Massachusetts in *imported early fruit*. We saw in the Orono market, July, 1889, a barrel of early sweet apples from Massachusetts literally alive with nearly full grown *Trypeta maggots*.

They may be found in Bangor or in any other railroad town in the State when early foreign fruit is exposed for sale. Is an Act to prohibit the importation of early fruits practical? We protect our game by an Act. Infected cattle are destroyed by law. Is the protection of our game and cattle more important than the protection of our fruit? We have no means of accurately telling the annual loss to fruit growers by this pest, but it must be considerable in the State. To many it amounts to from 10 per cent. to 75 per cent. of the crop There are only a few entrance ports and early fruit could be readily inspected, and if found infested confiscated and destroyed or the importation of early apples could be *entirely* prohibited. If fruit growers, knowing the facts, are

contented to allow their interests to be so jeopardized and make no effort to prevent it, they should without complaint bear the consequences. It is a matter of State interest for the pest is almost State wide in its occurrence. As a State, we can much better do without early foreign fruits than suffer the loss of our home products. No matter what methods are adopted to check this pest, they will prove more or less futile, if each year in all the railroad towns of the State, maggots by the hundreds are thrown upon the ground in worthless, infested, foreign fruit.

Direct Methods.

1. The flies are very stupid although they appear otherwise. When resting on the leaves or apples they can readily be taken with a small insect tube or bottle. By placing the mouth of the tube cautiously over them, they are not disturbed, and soon crawl inside. We took thirty this way from a single tree in an hour and a half. Making no allowance for mishaps and supposing a fly lays three hundred eggs and one-half of the flies are females, the progeny of a single fly the third season would be capable of laying nearly seven million eggs. The killing of even a few flies would materially lessen the number and help hold the pest in check.

2. Destroy the windfalls as soon as possible after they drop. This method has been recommended by every Entomologist who has written on the subject, as the *best* way to cope with the pest. It is based upon the positive knowledge that the maggots do not leave the fruit until it drops, and are found abundantly in the windfalls. These maggots if not destroyed enter the ground and appear three hundred-fold stronger the following season for the work of destruction. To destroy the windfalls makes dead maggots of them and dead things can not reproduce. It is common to not gather the fruit of infested trees, but allow it to drop and decay on the ground. *This is a bad practice, as it is the best way possible to multiply the pest.* It is a present loss of time and expense to destroy worthless fruit, but it will pay well in the end.

Two methods of destroying the windfalls suggest themselves:

(*a*) The windfalls may be collected and fed to stock in the yard or pasture. If carried to stock and thrown on the ground in quantities greater than are immediately eaten, there is danger that the maggots might leave them and go into the ground. This might be avoided by feeding no more than are eaten clean, and

storing any accumulated fruit in a tight box or bin, and, finally, destroying the refuse. Every provident orchardist should gather the windfalls as a matter of economy. If not profitable to feed they should still be destroyed to prevent the increase of insect pests and fungi which they harbor. Gathering the windfalls for the express purpose of checking Trypeta has been tried and found effectual. The making of cider from maggoty apples might be profitable, and would afford those who drink it both meat and drink at the same time, though it would not, if known, make a very appetizing beverage. We might as well save the trouble and expense of manufacture and eat the infested apples at once, or as Walsh has tersely expressed it, "Eat the devil as to drink his broth." If not needed to feed stock, they could be thrown into pits in convenient places in the orchard and after frost the refuse covered a foot or two with earth. It would be better to gather the windfalls every day and make thorough work of it. A boy could do it. If gathered every day it would not take much time. If impossible to gather every day, twice a week would destroy many, but would take longer to check the pest. In early varieties the gathering should begin by July 15th, and from late varieties as they begin to ripen and drop.

(b) Allowing enough sheep or swine in the orchard to eat the windfalls, would involve less time and expense and insure probably more immediate destruction. They should be turned in each day for a time, or kept in the orchard all the time from July 15th until the apples are gathered. It is some trouble and expense to destroy the windfalls. A troublesome pest necessarily involves time and trouble, and to exterminate Trypeta will require determined and thorough action.

Thorough and universal destruction of the windfalls is the most hopeful method, and fruit growers are urged to give it a thorough trial for two years.

3. Destroy the refuse from apples stored, marketed or used for home consumption. This is based on the fact that marketed fruit early and late is often alive with maggots. That pupæ in abundance are found in the bins and barrels where fruit has been stored. The chances that these larvæ find the conditions for development are much less than with those that go into the ground from the windfalls, but the pest may be spread by throwing infested marketed fruit on the ground.

(a) Infested, early apples, foreign and domestic, in market

places are a fruitful source of the pest, and fruit dealers should be required to burn or bury all apple refuse and not throw it on the ground.

The maggots are not able to crawl out of a box, and the refuse from market places could be thrown into a tight box or barrel and the maggots prevented from going into the ground. The refuse could occasionally be buried a foot or so deep.

(b) The maggots in stored apples sooner or later leave them and go into the pupa state in the barrels or bins. If marketed without sorting, the pupæ go with the fruit in the barrel and may spread the pest. The sorting floor should be swept if pupæ are found on it, and the refuse burned. In bins and barrels in the cellar the pupæ probably retain their vitality and if not burned the flies emerge in the spring. As a precaution the bins should be carefully swept and the barrels shaken into a tight vessel and refuse burned. Apple refuse from home use, known to contain maggots, should be destroyed and not thrown on the ground.

The writer's observations, to date, seem to indicate that the perpetuation of Trypeta from year to year is largely if not wholly due to the transformation of maggots that go into the ground, and that we have comparatively little to fear from the larvæ found in winter fruit picked and stored after frosts.

The pupæ found in barrels in December and placed in a jar in the cellar, without dirt, have not transformed. Some of the same lot put in earth December 25th have not changed. Maggots allowed to emerge from apples and transform in a box without dirt have not changed to flies. These facts would seem to indicate that pupæ exposed in open barrels for any length of time will not transform. Again, many of the larvæ in hard winter fruit die and do not reach maturity. It is not uncommon to find winter fruit full of the old trails of half-grown larvæ and the maggots dead in the channels, and the apple in a fair state of preservation. The subject needs further investigation, and the writer is at work upon it. Meanwhile it is best to destroy all pupæ found upon sorting floors or in bins or barrels.

The careful destruction of the windfalls and pupæ from stored fruit is, with little trouble or expense, within the control of fruit growers, and amounts to making an effectual trap of all trees infested.

The remaining sources of Trypeta, domestic and foreign marketed fruit, are not so easily controlled. Fruit growers should be

careful not to market infested fruit, and try to control the importation of early fruits. Great importance attaches to a knowledge of the pest and its habits, so that its first appearance in an orchard will attract attention and lead to prompt action against it.

Critical Remarks Upon the Anatomy of Trypeta.

Walsh, in the original description says the eyes are *black*, and no one seems to have corrected this error. The eyes fade in cabinet specimens and are dark, but even in these they have a decidedly greenish tint. The eyes are greenish in life, and in varying light give green, rusty brown and beautiful steel blue reflections. They are rarely variegated with brown patches. Walsh says: "The tip edge of the four basal segments of the abdomen white above." He seems to have overlooked the first basal segment, which is not at all white. The facts are, that in *both male* and *female* the white bands begin on the *second* basal segment and in the male involve the second, third and fourth, and in the female the second, third, fourth, fifth and occasionally the sixth. Loew makes the same mistake and says indirectly that there are only five segments to the female abdomen, while there are really *seven*. (See Plate I, Figure 3.) Walsh and Loew seem to have examined only a *single* female. Comstock apparently overlooked the basal segment of the female abdomen, as he says, the white bands "are borne by the *first* to the fourth segments inclusive." The sixth segment of the female abdomen is apparently represented only by the *tergite*, the segment being very narrow at the sides and below. The seventh bears the sheath and ovipositor contained within it. Walsh lets the reproductive system so severely alone, that it is certain he did not see the ovipositor, or he would have considered so important an organ. From Loew's account it would appear that he mistook the last segment of the abdomen for the ovipositor, and described that segment for it. The abdomen of the male as figured by Comstock is shriveled or distorted. We have before us twenty-five males and all show the ovate form, broadest at about the second segment. If there is any difference the male abdomen is broader in proportion to its length than that of the female. The form of the abdomen as figured by Walsh and Riley is essentially correct. Prof. Lintner also calls attention to the correct form of the abdomen.

The basal lobes of the wings are more prominent and rounded

than shown in Prof. Comstock's figure and the caudal margin sinuous, the sinuses being located where the second and third black bands touch the margin. The outline of the outer black bands of the wings are not curved and continuous (as shown in Comstock's figure) but quite irregular as shown in the corrected cut of the wings, Plate 1, Figures 1 and 2. There is also a subcostal vein above the one that is armed with spines, which is not shown in Comstock's figure, and to this the cross vein in front of the second black band joins and is not attached to the subcostal as shown in Comstock's figure.

Walsh says: "The tips of the four hind paws tinged with dusky." This statement usually applies to all the paws. Walsh, in describing the larva says: "That at the base of the first segment behind the head the spiracles are located." Comstock says: "There are at the union of the first and second segments pale brown tubercles, the cephalic spiracles." Comstock's figure represents them so located. If Walsh regarded the head as one segment, then his vague statement would imply, that he believed the spiracles located between the second and third. After examining many specimens, both alive and dead, we feel confident there are three segments in front of the spiracles as shown in Plate I, Figure 3. Prof. Comstock's figure of the full larva shows it at *rest* with the head and first segments telescoped and the anterior third of the body thickened. When fully extended the maggot is much more pointed in front. The hooks are less blunt than shown by his figure. The cut of the larva given in Saunders' Insects Injurious to Fruits is entirely misleading.

Prof. Comstock is the only one who has seriously studied the anatomy of this insect since Walsh and Loew's time, and though we have not confirmed some of his observations, yet his paper is really the only contribution to the internal anatomy and histology of *Trypeta pomonella* up to this time, though others have contributed to a knowledge of its habits and distribution.

Critical Remarks Upon the Life History of Trypeta.

The first reference we find to the notion that codling moth work bears any relation to Trypeta, occurs in Walsh's First Annual Report, 1868, where Mr. W. C. Fish is quoted as follows:

"I have found that in most cases the fruit had been previously perforated by the larva of the codling moth before being inhabited by the apple maggot."

Walsh evidently did not endorse this, as he says: "The eggs are inserted by the ovipositors of the flies into the flesh of the apple," a statement, which our observations confirm, though we are at a loss to know upon what data Walsh affirms so positively, as he did not describe the eggs, ovipositor, or make record of having witnessed oviposition. Walsh says Trypeta "never penetrates to the core," a statement not warranted by our observations, as maggots have frequently been found in the core, and sometimes the core almost eaten, as shows in Plate III, Figure 5. Walsh says Trypeta "*probably* feeds upon our native crabs." It should be noticed that he does not make record of having found it in crab appels. The statement restricting the appearance of the flies to July is partial knowledge rather than error and the result of limited observations. The other statements recorded by Walsh our observations have confirmed.

The matter upon the food habits and distribution of Trypeta was in print before we had access to Prof. Riley's article (Amer. Agric., July, 1872, p. 263) where the fact that the fly has been bred from wild crab apples is recorded. Prof. Riley has not experimented, but offers the following remedial measures, based upon the habits of the insect, that are worthy of a trial, viz: "covering the ground thickly with salt, ashes, lime or other substances" to prevent the emergence of the flies; "feeding the infested fruit to hogs or converting it into cider, and stirring or disturbing of the ground in spring so that birds and other predaceous animals may get at the pupæ." Prof. Riley also notices the fact that Trypeta sometimes affects the core of apples. "In N. Y. Semi-Weekly Tribune, Dec., 1876. Prof. Riley quotes Mr. Augur as saying that Trypeta "seems to prefer sweet apples but is found in R. I. Greenings and many other varieties, illustrating the wide range of the work of Trypeta. The statement made by Prof. Riley that the larvæ appear in late summer would be true only of the later races of flies, as the young maggots are found early in summer in early fruits. Prof. Riley implies that the flies are on the wing *only* in July, and that the eggs are *only* laid when the fruit is full grown, conclusions not warranted by our observations. He seems to endorse Walsh's view that the flies oviposit *in* the fruit, but afterwards has evidently changed his views, as he recently wrote the writer, that the insertion of the eggs into the flesh of the apple through the skin "is opposed to everything which we know regarding the egg laying habits of *Diptera*."

Passing by the writings of Loew, Packard and Glover, who record nothing new upon the habits of Trypeta, we come to Prof. Comstock's Report. The statement that crab apples are infested by Trypeta is not based upon observation. Prof. Comstock writes us he has not observed Trypeta in crab apples. Prof Riley seems to be the only one who has bred the fly from crabs, and his article recording this fact, (Amer. Agric., July, 1872) seems to have been overlooked by recent writers, their views being founded upon Walsh's statement of probability recorded above. It is to be doubted whether Trypeta occurs throughout the country where haws grow. We have not found apple maggots in haws in Maine, nor in Arkansas where the genus Crataegus is represented by a large number of species, nor in Iowa, but abundantly in Northern New York. The conclusions reached by Prof. Comstock, that Trypeta is "fastidious," and confines its ravages to a few varieties of fruit and is "much more apt to infest early apples," are not warranted by our observations. We find it attacks a wide range of varieties early and late, acid, sub-acid and sweet, and affects the early varieties not from fastidiousness but because the early races of flies are most abundant and appear when the early fruit is in proper condition to receive eggs.

The statement: "We seldom see the Trypeta until about the first of September, and never in green fruit," quoted by Prof. Comstock from a letter written by Mr. Hicks and left unchallenged, is incorrect. Prof. Comstock endorsed this view as follows: "According to my observations and all published accounts, the apple maggot does not occur in the apple till the latter part of the summer."

The eggs are laid in half grown fruit as early as July 1st, and maggots occur in abundance in July before early fruit has commenced to soften, and pupæ commence to be formed by August 1st. The statement that "in the autumn when the larvæ are full grown, they leave the apple and enter the ground," expresses only a part of the truth. Larvæ are transforming from August 1st until the middle of October from maggots found in apples in the orchard, but large numbers of young larvæ are stored with fruit and enter the pupa state in the bins and barrels, transforming sometimes as late as December, January or even February. The statement that the insect remains in the pupa state during early summer would not apply to the early appearing races of flies found on the wing by July 1st.

The contributions to the habits of Trypeta made by Prof. Comstock and not recorded by Walsh that our observations have confirmed, are that the larvæ go about one-half inch into the ground to transform and that in confinement the flies emerge earlier than in nature. Prof. Comstock seems to have studied the histology of Trypeta rather than its habits, and his contributions in that direction are more important.

Prof. Comstock suggests two remedies: the destruction of the windfalls and grafting the trees into later varieties and leaving a few early fruit trees for traps. We endorse the first, but the second we do not, as it is based upon the erroneous belief that Trypeta works almost exclusively upon early apples.

Prof. Cook rejects Walsh's position that the eggs are inserted in the flesh of the apple and erroneously says "the flies seek a nidus for their eggs *on* the apple." Again, "Several eggs are often laid *on* a single fruit." He incorrectly restricts the appearance of the flies to July, the occurrence of the maggots to September and early October, and pupation to early October. Again, he incorrectly says, Trypeta "is only found in the apples in early fall, and as it prefers soft, mellow fruit it is much more destructive to fall apples. I have found a few in winter fruit. From the fact that it only attacks fall fruit, it is, on the whole far less to be dreaded than the coding moth larva." The maggots occur in apples from early July until February, and attack early fruit, and in Maine several winter varieties badly, and it tunnels the whole fruit rendering it worthless. Its occurrence in time and its range in varieties being about the same as that of the codling moth and its work much more destructive, for these reasons *alone* we would regard it a worse insect. But its range over the country being much more limited and in a State its occurrence less universal, the damage done by it at present is less than the injury by codling moth larvæ. Prof. Cook has added the western localities, Michigan and Wisconsin, to our knowledge of the geographical distribution of Trypeta in cultivated fruit, and also recently has detected the apple maggot in plums and cherries in Northern Michigan.

Prof. Lintner perpetuates the errors of those who have written before him, by restricting the appearance of the flies to July, the egg laying to late July and August, the first appearance of larva so late as September, the pupation so late as autumn. He also advocates the view that the eggs are deposited *upon* the apples,

and the novel view that they are placed "near the *calyx* end, where the fruit *may* have been already burrowed by the apple worm." It is not certain from this statement what method of entrance into the fruit by the larvæ is advocated, but it may be implied that those from eggs laid in apple worm holes enter that way, and the others when hatched crawl to apple worm holes or bore directly through the peel where they are located. It makes but little difference now, as both are known to be wrong. Prof. Lintner evidently did not observe a fly with the ovipositor extended, or he would not have rejected Walsh's statement, and said the "blunt ovipositor could not pierce the peel" of the apple. He corrects the error that Trypeta is confined to early fruits, and recognizes its wider sphere of action. Prof. Lintner, under the head of "Desiderata in the Life History of Trypeta," mentions several points which need to be determined. The questions asked by him are all considered in this Report.

The statement made by Walsh, Comstock and Perkins, that Trypeta has not been found in cultivated apples in Illinois needs correction. In *Orchard and Garden* (October 1889, page 192) Mr. A. B. Cordley records its occurence in Illinois.

The following statements made by Prof. Perkins have not been confirmed: "The eggs must be deposited upon the apple. The ovipositor is too soft and blunt to pierce the skin of the apple. The maggots do not eat the apples until well advanced toward maturity. The eggs are not deposited on the fruit until the end of autumn."

Prof. Perkins expresses doubt about the eggs being locally placed on the apple, and implies that the larvæ gnaw through the skin when hatched, or sometimes enter codling moth holes. He also gives facts disproving Comstock's position that Trypeta is chiefly found in early apples. He also adds Vermont localities to our knowledge of its distribution and suggests several important lines of research, which were undertaken by the writer and are considered in this Report.

Mr. A. B. Cordley, in the article referred to above, records the occurrence of Trypeta in plums and cherries in Northern Michigan, and also speaks of Trypeta having been found in Illinois. The article seems to have been written to report the above facts, as nothing else is new, and many of the errors of previous writers are reiterated.

Mr. G. C. Davis in *The Ohio Farmer*, November 9th, 1889,

records the same facts reported by Cordley, but adds nothing new and leaves all the errors of previous writers unchallenged. He however, makes the novel and reasonable suggestion, that Trypeta may have acquired the habit of feeding on cultivated apples, "because cultivated apples became more plentiful or thorn apples less numerous."

The fact that Trypeta will feed upon plums and cherries is quite important as showing the adaptability of this insect to new food. Great care should be exercised before drawing conclusions and it is usually best to not decide a species without obtaining the perfect insect by transforming the larva. We have no reason to doubt the insect was *Trypeta pomonella*, though the species was decided from the larva and pupa. There is a European species, *T. signata*, Meigen, that infests the cherry, barberry and several other fruits, and *T. Ludens*, Loew (the Morelos Orange Fruit Worm) infests oranges in Mexico. The larvæ and pupæ of flies, especially of the same genus, are so nearly alike, and it being known that other species of the genus infest fruits, we hope Cook, Cordley and Davis will confirm their observations by rearing the flies from infested plums and cherries.

In Maine Agricultural Experiment Station Bulletin, No. 2, (Second Series), Prof. Harvey records the following new facts regarding the life history of Trypeta:

(*a*) The discovery of the eggs; the number of eggs the female deposits: that the eggs are inserted from *time* to *time*, *one* in a place, by means of a *sharp* ovipositor, through the skin of the apple; that the eggs are deposited in the fruit *before it is ripe* and in early fruit in early July; the time required for the eggs to hatch.

(*b*) That the larva becomes full grown in from four to six weeks; that they leave the apple through characteristic openings in the skin, and on grassy ground probably hybernate about the grass roots; that the larvæ stored in fruit leave it and go in the pupa state in the bins or barrels; that they occur in the fruit earlier and during a longer time than before recorded.

(*c*) That the flies are on the wing longer than before recorded; that the later races of flies affect the later fruit.

Additional new facts will be found recorded in this Report and some of those recorded in the above Bulletin modified or extended.

The Abstract of Maine Agricultural Experiment Station Bulletin No. 2 (Second Series), which occurs in *Station Record*, Vol. 1, No. 2, page 73, is incorrect in the following particulars:

It ignores the writings of Walsh, who should have received credit for the first account of the larva, pupa and flies, and implies that the credit should be given Prof. Comstock. Again, it gives Prof. Comstock the credit of describing and figuring the insect in *all* its stages. Prof. Comstock does not claim this honor, as he says (U. S. Agricultural Report, 1881-2, page 196): "I will now give an account of each of the stages of this insect, excepting the egg, which has not been observed." Prof. Comstock did not discover any of the stages of this insect, and the flies and larva were first figured by Walsh, and the pupa by Riley. Comstock's cuts of the fly, larvæ and pupa and anatomical details of the larva, though not the first published, are original. To the writer belongs the credit of discovering the eggs which are first described and figured in this Report. Again, the abstract implies that Prof. Harvey has simply confirmed the results of investigation by Prof. Comstock and has added nothing new regarding the life history of Trypeta. Credit should have been given for the facts spoken of above, which were recorded in Bulletin No. 2 for the first time. Again, the abstract gives Prof. Comstock the credit of discovering the remedial measures suggested by him, and makes the writer confirm his conclusions. Prof. Comstock advocates only two methods: destruction of windfalls and growing only later fruits and the leaving of a few early tree for traps. The first method advocated was not the result of Prof. Comstock's observations, but those of Mr. Isaac Hicks of Long Island. Prof. Comstock says: "The most practicable way of lessening the injuries caused by this pest are those suggested in the letters quoted above." Besides Prof. Riley had suggested destruction of the windfalls as early as 1872.

The writer has only confirmed the first of these methods but rejects the second. The second method is based upon the erroneous belief that Trypeta mostly confines its depredations to early fruit. The observations of other Entomologists and those of the writer show that this is not the case. The statement that Prof. Harvey confirms the results of investigations of Prof. Comstock in this and several other particulars is incorrect.

The above review of the literature on Trypeta shows how correct observations may be discarded for a long time and surmises and theories based upon incomplete or erroneous observations be reiterated and perpetuated.

It also suggests the importance of careful work on the part of

Entomologists that their writings be as free as possible from errors and that great care should be taken, especially in quotations, to keep theories and surmises distinct from facts obtained by careful research.

Notes on Other Insects.

While studying Trypeta, observations were incidentally made upon other insects. The late appearance of Codling moth larvæ in apples, examined in 1888, would suggest that the eggs of the spring brood may be deposited on apples after they are considerable size. This would have an important bearing upon the proper time to spray with arsenic solutions. It might be better to wait until apples are as large as marbles than to spray when they are only the size of peas as is done in Maine. Codling moth larvæ, one-half grown, were found in apples in November, 1888. In 1889 we noticed much insect work in stored late apples, which appeared to be that of half grown codling moth larvæ. It would seem that there is a second brood of this insect in Maine, but that the larvæ are only half grown when frost appears and they probably perish. The second brood cannot be reached by spraying and considerable damage is done by it. The fact that but few apples affected by the Plum Curculio were noticed after August, would indicate that this insect works early in the season and that the apples affected drop early. The cuts were quite abundant early in July, showing this insect does considerable damage to the apple. A large number of the punctures were abortive, no larvæ being found in them, while frequently dead larvæ were noticed in the channels made by them. Only a small per cent. matured and transformed. This would seem to show that this insect does not find in the apple the most favorable condition for its development. Its injuries are not confined to the apples in which the larvæ mature but all apples stung either drop or are poisoned. Those that do not drop are dwarfed and growth in the vicinity of the punctures arrested. This insect was considered in Report for 1888. Considerable work, supposed to be that of the Ash-gray Pinion was observed the past season. The larvæ of this moth eats holes into the sides of apples.

EXPLANATION OF PLATES.

These plates were prepared by the Moss engraving process. Where a short line occurs by a figure it indicates the natural size of the object.

EXPLANATION OF PLATE I.

Figure 1. The female fly of the apple maggot (*Trypeta pomonella*, Walsh) magnified about eight times. Modified from a drawing made by Mrs. A. B. Comstock and found in the United States Agricultural Report, 1881-2, Plate XIV. The abdomen is entirely original and shows the ovipositor extended, and also the sheath. The black bands, veining and basal lobes of the wings are also modified to agree with the writer's observations.

Figure 2. The male fly of the apple maggot (*Trypeta pomonella*, Walsh) magnified about ten times. The abdomen original. The bands, veining and basal lobes of wings modified as stated under Figure 1. The genitalia are not shown, being retracted beneath the abdomen.

Figure 3. The larva of the apple maggot (*Trypeta pomonella*, Walsh) magnified about twelve times. A side view of the maggot with the head extended and the hooks protruding, original and showing three segments in front of the spiracles to agree with the writer's observations.

Fig. 1

Fig. 2.

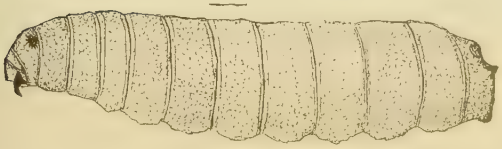


Fig. 3.

APPLE MAGGOT.

(*Trypeta pomonella*, WALSH.)

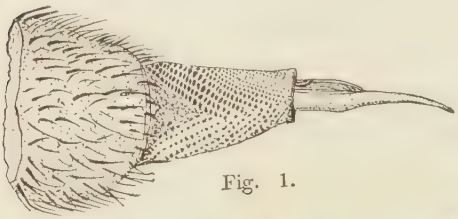


Fig. 1.

Fig. 2.

Fig. 4.

Fig. 6.

Fig. 8.

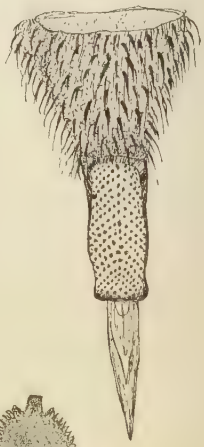


Fig. 3.

Fig. 5.

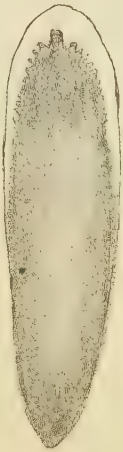


Fig. 7.

Fig. 9.

APPLE MAGGOT.

(*Trypeta pomonella*, WALSH.)

EXPLANATION OF PLATE II (Original.)

The Apple Maggot.

(*Trypeta pomonella*, Walsh.)

Figure 1. Last abdominal segment, sheath and extended ovipositor (female) magnified about thirty times.

Figure 2. External genital apparatus of male (enlarged.)

Figure 3. Last abdominal segment, sheath and ovipositor from below, magnified about thirty times.

Figures 4 to 9. Eggs in different stages of development. Figure 4 shows eggs as found attached in the ovary.

Figure 8. Shows the reticulated markings on the egg shell at the pedicellate end of the egg.

EXPLANATION OF PLATE III.

The Apple Maggot.

(*Trypeta pomonella*, Walsh.)

Figures 1a, 1b, 1c and 2 are copied from Mrs. A. B. Comstock's admirable drawings in United States Agricultural Report, 1881-2, Plate XIV.

Figures 3 and 4 were photographed by Mr. L. H. Merrill from slides prepared by the writer.

Figures 5 and 6 are original.

Figure 1a. Side view of anterior end of the larva, showing jaw system, portion of trachea and cephalic spiracle.

Figure 1b. Anterior end of larva viewed from above, showing jaw system and spiracles.

Figure 1c. Enlarged view of caudal spiracle showing the three transverse slit-like openings and the four groups of bristles.

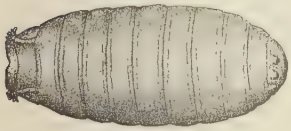
Figure 2. Dorsal view of the pupa, magnified about ten times.

Figure 3. Portion of apple peel showing the puncture made by the ovipositor of the female, magnified about thirty times.

Figure 4. Portion of apple peel showing an exit-opening of the larva, magnified about five times.

Figure 5. Cross section of High Topped Sweeting showing advance work of full grown larvæ, natural size.

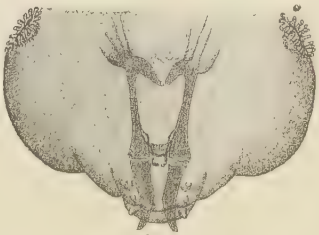
Figure 6. Cross section of a Winthrop Greening showing the work of half grown larvæ, natural size.



2

1c

1a



1b

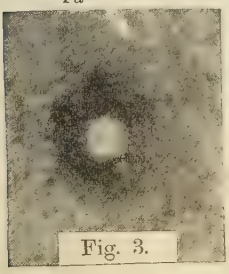


Fig. 3.

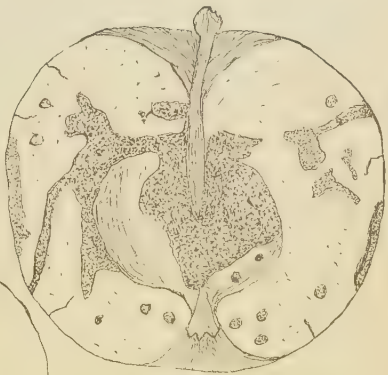


Fig. 5.

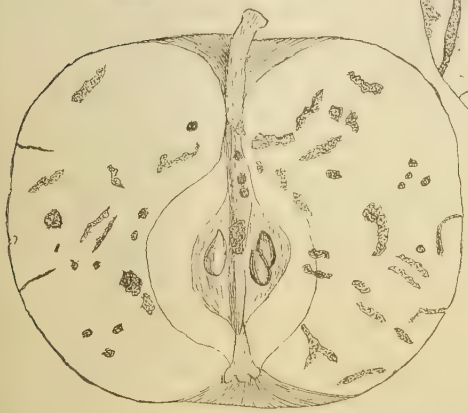


Fig. 6.

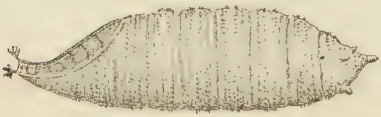
Fig. 4.

(*Trypeta pomella*, WALSH.)

1

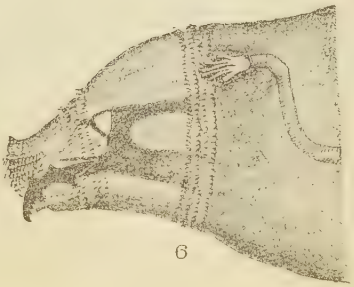
2

4a 4



3

5



6

7

8

A. B. Comstock del.

VINE LOVING POMACE FLY.

(Drosophila Ampelophila, LOEW.*)*

EXPLANATION OF PLATE IV.

(After Comstock.)

(*Drosophila Ampelophila*, Loew.)

Figure 1. Adult.

Figure 2. Ventral aspect of puparium.

Figure 3. Lateral aspect of puparium.

Figure 4. Tarsus of prothoracic leg of adult male; 4a, tarsal appendage.

Figure 5. Cephalic spiracle.

Figure 6. Lateral aspect of cephalic end of larva.

Figure 7. Egg.

Figure 8. Larva.

INSECTICIDES.

The necessity of using insecticides needs no argument. There are so many insects that feed upon vegetation, and do much damage to forests, orchards, field and garden crops, that it has become necessary to destroy or hold them in check. The use of poisons that will insure wholesale destruction at a moderate cost is the only practical method of coping with them, therefore insecticides have come rapidly into use within a few years. It is important that all orchard owners should become converts to this policy so as to insure universal application of insecticides. It would be better if some other way could be found to destroy insects, as the use of poisons is attended with more or less danger to man and stock. There is yet considerable prejudice against the use of poisons, and many are deterred from using them, especially in orchards in grass or in pastures, for fear of poisoning stock. The wholesale use of Paris Green upon potatoes has made us familiar with poisons and demonstrates that when properly used the danger is small. It should, however, always be remembered that too great care cannot be exercised with poisons and the following precautions should be carefully observed:

1. Insecticides should be carefully labeled *Poison* and kept out of the reach of children.

2. Never handle poisons with the bare hands. Oil the hands as a precaution and cover any sores with court plaster. Light leather gloves would be advisable.

3. While spraying, keep to the windward of the trees. Wash thoroughly after spraying work. Keep children out of the orchard while such work is going on.

4. The trees should not be sprayed until there is much dripping, but as a precaution stock should be kept out of the orchard for a week or two after spraying. The amount of poison that gets on the grass in properly conducted experiments is not enough to poison stock, but proper precaution is advisable. Prof. Cook sprayed in the ordinary way, and then cut and fed the clover under the tree to a horse, without producing symptoms of poisoning. The amount of poison put on an apple tree for codling moths is so small, that if it all remained, no poisonous effects would be noticed by eating an ordinary amount of the fruit. The usual formula for spraying trees is one pound Paris Green to eighty gallons of water and three gallons to a large tree. This would make

253 grains of the poison per tree. Now supposing half of it fell upon the fruit and half on the leaves and branches, and the tree bore ten bushels of apples, this would make 13 grains to a bushel of fruit. There are about 200 ordinary sized apples in a bushel. This would leave only seven one-hundredths of a grain to an apple which is much less than a poisonous dose. Considering that the poison is applied when the fruit is small and long before harvest, and that the rains would wash much of it off, the danger of poisoning is small.

5. In dusting vegetables or plants with dry poisons care should be taken not to inhale them. See that the dry dust is not carried by the wind to berries, vegetables or fruit soon to be gathered. It is best not to plant berries or vegetables near orchards or shrubbery that have to be sprayed.

Conditions.

To have insecticides work properly the material must be good and the application properly made.

1. As there is considerable adulterated material on the market it is best to procure poisons, even at a higher price, from reliable dealers who will warrant their goods.

2. Great care should be exercised in properly mixing the material. When it is only held in suspension and not soluble in water it should be kept thoroughly stirred while being applied.

3. The application should be by an even fine spray and with force enough to reach every part of the tree or plant.

4. If the material seems to burn the leaves it is too strong and should be diluted.

5. The proper time to spray is of great importance. It should be done when the insect, or fungus is in the proper stage of its life to be reached by the poison.

6. If a hard rain follows the spraying it should be repeated. Several applications are often necessary during the season.

Common Insecticides.

The injurious insects that can be destroyed by the application of insecticides are of two kinds: Those provided with biting jaws for eating the foliage of plants, and those provided with sucking apparatus and living upon the juices of plants. Those having biting

jaws take the substance of the leaves into the stomach and can be killed by poisoning the leaves. Those living upon the juices can be reached only by the application of substances which act externally; stopping the breathing pores, irritating the skin, producing offensive odors or acting as mechanical barriers. The poisons in common use that act internally, applied in the form of a powder or in suspension, are paris green, London purple and white arsenic. Those used externally in the form of a powder are hellebore, pyrethrum, sulphur, lime, plaster, ashes and dirt. Those applied in the liquid form are kerosene emulsion, whale oil soap and sulphur, strong soap suds, tobacco decoction, bisulphide of carbon, benzine, gasoline and coal tar.

Insecticide Apparatus.

Material used for destroying insects is applied either as a dry powder, or dissolved, or suspended in water, or some other liquid. The kind of apparatus used would depend upon the method of application. *For Applying Powder*, powder blowers are useful. These have long discharge tubes, by means of which the powder is carried considerable distance. The following machines have claimed more or less attention for their efficiency: The *Woodason Bellows*, made by Thomas Woodason, Philadelphia, Pa. These throw the powder 8 or 10 feet and with a ladder small trees can be wholly reached. The *Orchard Gun*, made by Leggett Bros., New York, is provided with a tin tube in sections 5 to 16 feet. There is a fan that works with a crank. Above the fan there is a can to hold the powder, which has a perforated bottom. The crank works a sliding plate, which lets the powder into the tube at each revolution. This instrument is efficient for some kinds of work. Weight, 7 lbs.

For applying liquids a good force pump and nozzle are essential. Below we consider some good pumps and nozzles that have been tried and found efficient.

For small operations any good hand pump, aquaject, syringe, or hydronette would answer the purpose.

When the orchard exceeds five or ten acres a larger machine would be more desirable.

Any of those mentioned below, or a good pump of any manufacture, arranged for attachment to a barrel or tank, and provided with a suitable hose and nozzle, would answer the purpose.

Pumps with two discharge pipes allow two sprays to be thrown

at once. One man can work the pump and two do the spraying. When only one spray is needed the other discharge pipe can be provided with a return tube to the tank or barrel and serve as an agitator and keep the liquid stirred. Where larger machines are used a team is almost necessary, the apparatus being placed in a wagon and the spraying done from it. A hand cart, a wheelbarrow, or a stone boat and horse can be used. If high spraying is to be done, (large orchard or shade trees,) a long hose will be found necessary. With a light ladder, and a hose long enough, the tops of high trees can be reached, or the hose can be attached to a light bamboo pole and the spraying done from the wagon or ground.

A good quality of 1-4 inch cloth insertion rubber tubing is strong enough for all ordinary purposes. A larger sized hose would be too heavy, unwieldy, increasing the work and cost.

It would be difficult to get an extension pole strong enough and light enough to support a long, heavy hose. Thirty feet of discharge hose is sometimes necessary for high spraying.

Below we give the addresses of reliable firms, who manufacture spraying apparatus. We would advise those who intend to purchase apparatus to write for circulars and examine the claims of the various kinds offered before deciding. As the outfit purchased will depend upon the use, and as this may not be clear to all, the *writer* will take pleasure in answering questions addressed to him regarding spraying apparatus.

A good outfit for heavy operations embracing the best materials need not exceed twenty dollars. The outfit may be purchased in parts of diffierent firms or complete outfits are offered by manufacturers at from $10 to $50, according to style.

Responsible Firms.

Thomas Woodason, 451 E. Cambria Street, Philadelphia, Pa.; Leggett Bros., New York; W. & B. Douglass, Middletown, Conn.; Rumsey & Co., Seneca Falls, N. Y.; Field and Force Pump Co., Lockport, N. Y.; Robert T. Deakin & Co., Philadelphia, Pa.; Nixon Nozzle & Machine Co., Seneca Falls, N. Y.; Thomas Summervile & Sons, Washington, D. C.; Columbia Brass Works, 1216 D St., Washington, D. C.; Adam Weaber, Vineland, N. J., and P. C. Lewis, Catskill, N. Y.

ACKNOWLEDGMENT.

We desire to acknowledge the donation to the Experiment Station of the following pieces of spraying apparatus: From Rumsey & Co., Seneca Falls, N. Y., a Florida Spraying Pump complete; from Nixon Nozzle & Machine Co., Dayton, Ohio, a Little Climax Pump complete; from C. P. Lewis, Catskill, N. Y. a Combination Force Pump; from Gould Mf'g Co., Seneca Falls, N. Y., a Magic Nozzle; from Thomas Summerville, Washington, D. C., a Cyclone Nozzle and a Vermorel Improved Nozzle.

The above pieces of apparatus were placed on exhibition at the Norway meeting of the State Pomological Society, where they were explained by the writer. They were kindly turned over to the Experiment Station to be used in experimenting and illustrating lectures on spraying to the classes in Economic Entomology at the Maine State College. The writer has tried the above pieces of apparatus and can recommend them.

DESCRIPTION OF APPARATUS.

The cuts illustrating this article were furnished free of expense by the various firms whose spraying apparatus they represent.

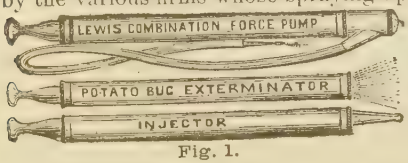


Fig. 1.

Figure 1 shows Lewis' Combination Force Pump, manufactured by C. P. Lewis, Catskill, N. Y., and sold for $6.00. This is a handy instrument to have about the farm and has the element of cheapness. It is a combination of three instruments in one; a force pump, an agricultural syringe and a veterinary syringe. It can be used to wash wagons and windows, sprinkle gardens and lawns, and also to spray shrubbery, potatoes and small orchards.

Belonging to the above class of pumps may be mentioned: The Gould Portable Brass Force Pump, sold for $9.00; the Aquaject, made by Rumsey & Co., Seneca Falls, N. Y., for $9.00. (This price includes suction and discharge hoses and a rose sprinkler.) And the Hydronette made by Rumsey & Co., and including hose, nozzle and sprinkler, sold for $8.00.

LITTLE CLIMAX

Fig. 2.

Figure 2 represents the Little Climax Pump manufactured by the Nixon Nozzle and Machine Co., Dayton, Ohio.

"It is made of iron and brass, all parts that have to bear any considerable strain being malleable. The pump is firmly bolted to a strong iron base, supported on three legs made of gas pipe. These legs are unscrewed and the pump is put in a

small, neat box for shipping, and they are easily screwed into place by the purchaser. The legs are turned out at the bottom sufficiently to make them stand firmly. There are furnished with this pump four feet of 1-4-inch cloth insertion, rubber tubing and two climax nozzles; also suction hose, as shown in the cut, to draw the liquid from the bucket or other vessel, as the case may be. There is also furnished the rod for holding the hose, as shown in the cut; with this the spray may be thrown straight upward, out at any angle desired, or horizontally, without touching the hose or turning a screw. This is suitable for spraying in green houses, flowers and shrubs on the lawn, or for garden and small orchard work. Price $10.00."

We are using the Little Climax pump and Nixon Nozzle for some spraying work this season. We had the pump fitted like Climax No. 2, with a 12-foot hose and barrel attachment. Arranged that way it cost about $13.00.

CLIMAX PUMP NO. 2.

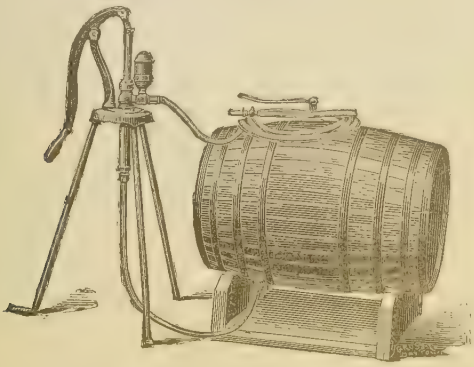


Fig. 3.

Figure 3 shows Climax Pump No. 2, fitted with long hose, barrel attachment and agitator. This pump is like the Little Climax in construction, only larger. It can be attached to any kind of vessel or tank by means of our brass connections in ten minutes; or the suction hose can be dropped into a barrel, trough or cistern with equal success. This pump is sold complete, with twenty feet of hose, two nozzles and the necessary connections for it, as shown above. The barrel or vessel is shown in the cut to give an idea of a practical manner of connecting it. Any person can prepare this barrel and rack, as shown above, in a few minutes. The

agitator, the handle of which is shown on the top of the barrel, is a very complete and successful thing. It costs $1.00 extra. Price without agitator and barrel $15.00. This apparatus is provided with the Nixon Nozzle and especially adapted for large orchard work.

THE FLORIDA SPRAYING PUMP.

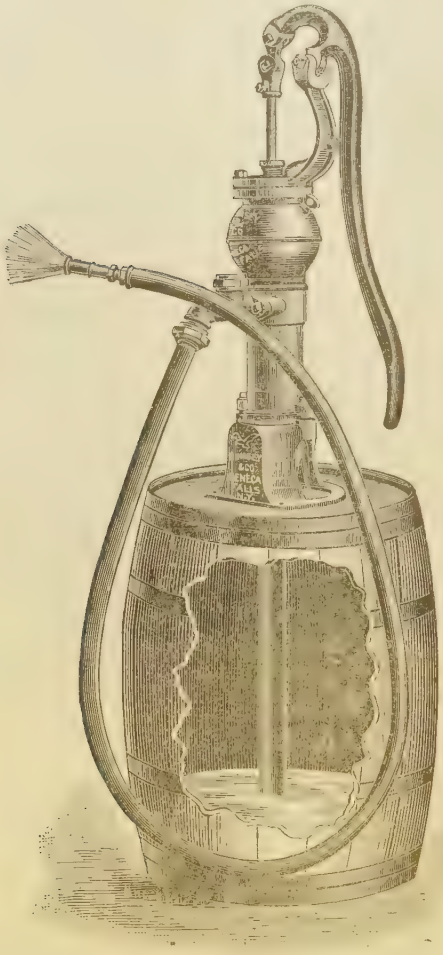


Fig. 4.

Figure 4 shows the Florida Spraying Pump manufactured by Rumsey & Co., Seneca Falls, N. Y. It consists of a force pump with hose and nozzle attached and a pipe to extend to the bottom of a barrel. Price, with 3 feet of hose, spraying nozzle, and sufficient 1 1-4-inch gas pipe to reach the bottom of an ordinary barrel, $12.00.

Figure 5 represents the Gould Double-Acting Spraying Pump, manufactured by the Gould Mf'g. Co., Seneca Falls, N. Y. This pump is arranged for either hose or gas pipe discharge, or spraying. Being double-acting it throws a continuous powerful stream. Both discharge orifices can be fitted with hose and two sprays used at once, or one of the discharges can be used at once, as a return pipe to mix the contents of the barrel. Fuller directions accompany the pump.

Gould's Double-Acting Spraying Pump.

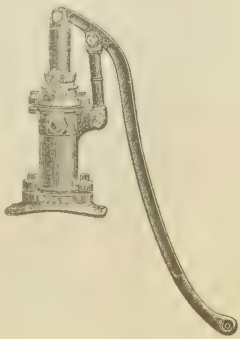


Fig. 5.

SIZES, PRICES, ETC.

No.	Dia. Outer Cylinder.	Suction.	Double Hose Discharge.	Double Pipe Discharge.	All Brass Piston or smaller Cylinder and Brass outer Cylinder.	All Brass Piston or smaller Cylinder and Iron outer Cylinder.
2	2½ inch.	1 inch.	¾ inch.	½ inch.	$14.00	$8.50

With metallic fitted lower valve, $2.50 net, extra.

☞ *These Prices include a brass Suction Basket, but no Pipe, Sprayers, Hose or Couplings. We can furnish any fittings as ordered, at lowest market rates. Advise in orders, whether wanted for hose or wrought iron pipe suction and discharges, and if Pumps are wanted fitted complete for any special work we should be so advised.*

The Japy Pump offered for sale by the Columbia Brass Works, 1216 D St., Washington, D. C., for $21; the Eureka Pump manufactured by Adam Weaber of Vineland, N. J., and sold for $21.65; and a machine constructed by Mr. Roland Thaxter, for experiments at the Conn. Expt. Station at a cost of $9.80, are arranged to strap on the back so the spraying can be done while walking.

Fig. 6.

Figure 6 shows the Eureka pump in action. I is provided with a reservoir, a pump operated by a lever, and an air chamber to insure a continuous stream. By means of a hose any suitable nozzle can be attached. These pumps are especially handy for spraying low plants and shrubbery.

Fig. 7.

Figure 7 shows the Automatic Spraying Machine, made by Adam Weaber that accompies the Eureka pump.

The Japy and Eureka pumps are quite expensive, and to meet this objection, Mr. Thaxter, Mycologist for the Connecticut Experiment Station, devised and used with satisfaction an apparatus which is figured and described in Bulletin 102, Connecticut Agricultural Experiment Station, March 1890, from which we take the following cut (Fig.8) and description. "This apparatus consists of an ordinary copper wash boiler of the smallest size and a force pump

of the "hydronette" or "aquanette" pattern. A tank made like a copper boiler but about half as large as the smallest wash boiler can be made with the fittings represented in the cut, of copper with tight fitting tin cover for about $2.50, at any tin house. A piece not quite large enough to admit the hose of the

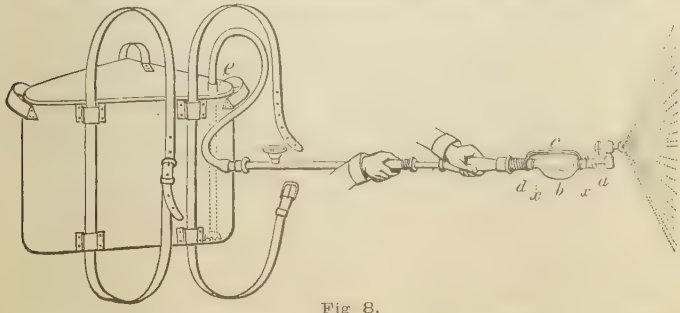


Fig 8.

hydronette is cut out from the edge of the boiler cover at *e*, and a short collar of tin soldered into it with a slot broad enough to allow the hose to be pushed into it sideways. (This socket is misdrawn in the cut, the broken rim of the cover not being connected vertically with edges of the collar as they should be.) The hose when pushed into the socket therefore projects just enough to be firmly held against the side of the boiler when the cover is shut down. A couple of wire catches may be necessary to hold the cover on firmly, if it is not very tight; and in addition the boiler should be fitted with straps as in the cut, or in any other convenient manner so that it can be carried on the back of the operator.

Since pumps of the "hydronette" pattern do not throw a steady stream, acting only when the piston is driven back, some appliance is necessary to produce an even, continuous spray. This is very readily provided as shown by the cut. A piece of 5-8-inch heavy but elastic rubber "*tubing*" (*b*)—hose will not answer—is fastened to a "Vermorel" nozzle (*a*) at one end (*x*) and to the hydronette nozzle (*d*) at the other end (*x*), by winding it tightly with a few inches of small copper wire. Unless the rubber tube is used with care it is liable to burst. This is readily obviated by taking a rectangular piece of strong, cotton cloth and sewing the two opposite edges together firmly so as to make a cloth cylinder 5 1-2 inches in circumference which may be slipped over the 5-8-inch tubing and wound firmly at either end so as to keep the rubber from becoming unduly distended. Fresh rubber is better than that which

has lost its elasticity to any extent from age. The two nozzles (*a*) and (*d*) are then connected by two heavy copper wires (*c*) fastened by winding once or twice around each nozzle. The Vermorel nozzle is thus held firmly in place, and, as the wire will stand any amount of bending, the direction of the stream is easily regulated in this way. The length of the copper wire and rubber tubing may be increased as desired; for spraying the under side of the leaves of low shrubs, for instance, the wire being bent so as to send a vertical stream; but six inches of tubing is about as short a length as will furnish sufficient elasticity for producing a steady stream. The pump may be also used for spraying trees by using the necessary length of small hose furnished with a spray nozzle at one end, and connected at the other with a piece of rubber tubing long enough to allow free motion to the piston. The hose can then be fastened to a light pole and the body of the pump so fastened to its base as to allow free movement of the piston.

The apparatus can of course be used without the copper boiler, by carrying the substance to be sprayed in a pail or other vessel; but when liquids are used, such as the Bordeaux mixture or Paris green in water, which have to be kept stirred while being used, the boiler gives far less trouble, since the motion of the body keeps its contents stirred up while in use. The apparatus has thie additional advantage that, by procuring an extra hydronette nozzle or a coupling which will serve to attach the sprayer as described, the spray nozzle and its adjuncts may be screwed off as a whole when not in use, and the ordinary nozzle substituted; so that the pump may be also employed for any of the many purposes for which it is useful. The cost of this apparatus, not including straps or strainer, is about as follows:

Copper boiler (No. 7)	$3.25
Hydronette pump	4.00
Wire and rubber tubing	.20
Fittings to boiler	1.00
Vermorel nozzle	1.25
Total	$9.70

In "The Journal of Mycology," Vol. 6, No. 1, March, 1890, p. 26; we find the following from the pen of Prof. B. T. Galloway: "We have had the matter of providing a cheap, serviceable knapsack pump under consideration for some time, and can now positively announce that the machine will be on the market in a

few weeks. The pumps will be made in two or three styles, and as there is no patent on them, we hope manufacturers throughout the country will be able to offer them at about $12, thus placing them within the reach of all."

THE "BOSS" NOZZLE.

Figure 9 represents the "Boss" Nozzle, manufactured by Rumsey & Co., Seneca Falls, N. Y. "It will throw a coarse or fine spray, or a solid stream."

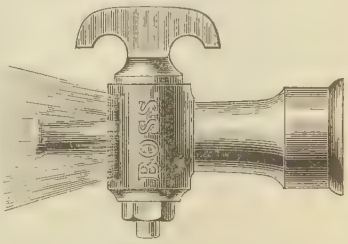


Fig. 9.

Size	¾ inch.	1 inch.
Per Dozen, Nickel Plated	$12.00	$14.00

THE "GEM" NOZZLE.

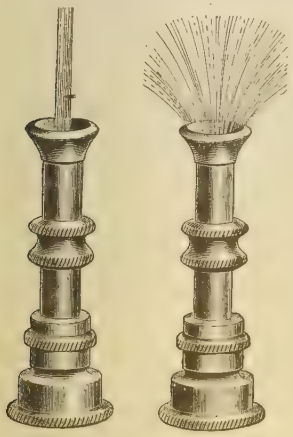


Fig. 10.

Fig. 10 represents the Gem Nozzle offered for sale by Rumsey & Co., Seneca Falls, N. Y. "By means of an adjuster near the butt, it can be graduated to throw a solid stream, a spray or be shut off entirely, while the pump is in operation"

Size	¾ inch	1 inch
Per Dozen	$9.00	$12.00

Figure 11 represents the Magic Nozzle, offered by the Gould Mf'g Co., Seneca Falls, N. Y. "Will throw coarse or fine spray; a large or small solid stream by revolving nozzle part way around."

Fig. 11.

Price, ¾ inch, per dozen	$10.00
Price, 1 inch, per dozen	12.00

THE CLIMAX NOZZLES.

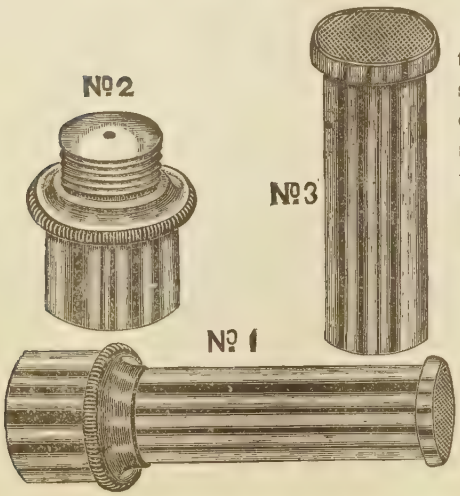


Fig. 12.

Figure 12 illustrates these nozzles. No. 3 shows the outer end covered by a wire screen, which cuts the water into spray. No. 2 shows nipple end of same. No 1 shows the nozzle entire.

The nozzles are simple in construction, cannot get out of order, and are very durable, being made of brass They are all fitted with standard-pipe thread, and will fit corresponding sizes of gas pipe and hose coupling. They are made of various sizes, numbered from 1 to 6, and will produce spray from the density of fog to any desired coarseness as may be required. Nozzles Nos. 1 to 5 are intended for conservatory, flower garden, orchard and field use. No. 6 is for lawn and street use. Price, $1.00.

Besides the nozzles mentioned above, are the Cyclone Nozzle with the Eddy chamber and the Improved Vermorel made by Thos. Summerville & Sons, Washington, D. C., the former sold for 50 cents and the other for $1.50.

FRUIT TESTS.

The following is a list of the large and small fruits which the Station has under cultivation. This list will be greatly enlarged in 1890.

The object of this work is to test the value of these fruits, not only in the vicinity of the Station, but in various other parts of the State. It is especially necessary to secure a trial of new or untried varieties of apples in several localities, as a success or failure of a particular apple in one place should not be accepted as conclusive with regard to the whole State. To this end it is proposed to distribute scions to apple growers in different sections of Maine, to be used in top grafting, as in this way definite results will be soonest reached. Scions were cut last fall from nearly all the varieties of apples given in the list, many of which will be distributed the coming spring.

LIST OF FRUITS SET AT THE STATION IN 1889.

APPLES.

Alexander.
Bellflower.
Canada Russett.
Chenango.
Early Strawberry.
Fallawater.
Fameuse.
Gravenstein.
Hubbardston.
Hurlburt.
Jonathan.
King of Tompkins.
McIntosh.
McLaughlin.
Mother.
Newtown Pippin.
Northern Spy.
Peach of Montreal.
Peck's Pleasant.
Pewaukee.
Red Bietigheimer.
Red June.
R. I. Greening.
Rome Beauty.
Roxbury Russet.
Schiawasse Beauty.
Scott's Winter.

PLUMS.

Bavay's Gage.
Bradshaw.
Coe's Golden.
Damson.
Duane Purple.
Gen. Hand.
German Prune.
Imperial Gage.
Italian Prune.
Jefferson.
Lombard.
Prince Englebert.
Yellow Egg.

PEARS.

Josephine of Malines.

CHERRIES.

English Marella.
Gov. Wood.
Large Montmorency.
May Duke.

GRAPES.

Amber Queen.
August Giant.
Bridgton.
Champion.
Concord.
Delaware.

APPLES.

Smith's Cider.
Stump.
Twenty Ounce.
Wagner.
Walbridge.
Yellow Transparent.

CURRANTS.

Lee's Prolific.
Red Dutch.

GOOSEBERRIES.

Industry.

BLACKBERRIES.

Erie.
Snyder.
Taylor's Prolific.
Wild Blackberry.

RASPBERRIES.

Carmen.
Cuthbert.
Golden Queen.
Gregg.
Herstune.
Rancocas.
Shaffer.
Wild Raspberry.

GRAPES.

Diana.
Empire State.
Hartford.
Lady.
Moore's Early.
Prentiss.
Salem.
Vergennes.

STRAWBERRIES.

Belmont.
Bubach.
Chas. Downing.
Crescent.
Cumberland.
Golden Defiance.
Henderson.
Jersey Queen.
Jessie.
Jewell.
Jucunda.
Lady Rusk.
Manchester.
Mt. Vernon.
Sharpless.
Triomphe De Gand.
Wilson.

MAINE AGRICULTURAL EXPERIMENT STATION.

Entomological Paper No.3.

Apple maggot, Trypeta pomonella, Monograph. By F.L. Harvey pp.1-49, 4pls., 26 figs.

This paper is out of print, but the reader is referred to No.2(pp.190-237) in which almost the same information is given.

Report of Botanist and Entomologist.*

Prof. F. L. Harvey.

Below is given an outline of the subjects considered by the division of Botany and Entomology during the past season.

BOTANY.

1. Germination Experiments.
2. Testing varieties of grasses.
3. Spraying Experiments for Apple Scab and Codling Moth.
4. Spraying Experiments to determine minimum amount of Paris Green for Potato Beetles.
5. Causes of Potato Scab. Consideration of investigations by Messrs. Bolley and Thaxter.
6. Correspondence about Strawberries.
7. *Plantago lanceolata*, Linn. Rib Grass or English Plantain described and Illustrated.
8. *Leontodon autumnalis*, Linn. Fall Dandelion considered and illustrated.

ENTOMOLOGY.

9. *Platysamia Cecropia*, (Linn.). Cecropia Emperor-moth.
10. *Orgyia leucostigma*, (Sm. & Abb.). White-marked Tussock-moth.
11. *Hyphantria cunea*, Drury. Fall Web-worm.
12. *Tmetocera ocellana*, (Schiff.). Eye-spotted Bud-moth.
13. *Schizoneura lanigera*, (Hausm). Woolly-louse of the Apple.
14. *Œdemasia concinna*, (Sm. & Abb.). Red-humped Apple-tree Caterpillar.
15. *Anisopteryx pometaria*, Harris. Fall Canker-worm.
16. *Clisiocampa sylvatica*, Harris. Forest Tent-caterpillar.

Plants of Economic Importance Received for Examination in 1890.

No.	Common Name	Scientific Name.	From Whom.	Depredations, &c.
1	Orange Hawk weed.	Hieracium aurantiacum.	Geo. S. Paine, Winslow, Me.	Weed in meadows.
2	Field Sow Thistle.	Sonchus arvensis, L.	H. H. Cook, Presque Isle.	Weed in grain fields.
3	Reed.	Phragmites communis, Trin.	M. F. Reed, East Bradford.	Growing in low ground.
4	Black Knot.	Plowrightia morbosa, Saco.	J. Q. A. Butts, Canaan.	Parasitic on cherry trees.
5	Oats.	Avena sativa.	Joel Richardson, N. Newport, Me.	Specimens turned yellow by wet weather. No parasite.
6	Rib Grass or Eng. Plantain.	Plantago lanceolola, L.	Various Parties.	A weed in fields and meadows.
7	Fall Dandelion.	Leontodon autumnalis.	Various Parties.	Weed in fields, meadows and along roadsides.

* Part from the Annual Report of the Entomologist for 1890.

INSECTS REPORTED AND EXAMINED—1890.

No.	Common Name.	Scientific Name.	Depredations.
1	Cecropia Emperor-moth.	Platysamia Cecropia, (Linn.).	The cocoon was received.
2	White-marked Tussock-moth.	Orgyia leucostigma, (Sm. & Abb.).	On apple trees and rose bushes.
3	Fall Web-worm.	Hyphantria textor, Harris.	On apple trees.
4	Eye-spotted Bud-moth.	Tmetocera ocellana, (Schiff.).	In blackberry buds.
5	Woolly-louse of the Apple.	Schizoneura lanigera, (Hausm).	On leaves and twigs of apple trees.
6	Red-Humped Apple-tree Caterpillar.	Œdemasia concinna, (Sm. & Abb.).	On leaves of apple trees.
7	Fall Canker-worm.	Anisopteryx pometaria, Harris.	On shade and apple trees.
8	Forest Tent-caterpillar.	Clisiocampa sylvatica, Harris.	On forest, shade and fruit trees.
9	The May-beetle.	Lachnosterna fusca, (Frohl.).	Feeding in larval state on grass roots.

Remarks.

Those of the above named plants and insects that have been studied and are of sufficient importance are considered below. The fine plates illustrating Rib Grass and Fall Dandelion were prepared by Miss Kate Furbish, Brunswick, Me. The cuts illustrating insects were obtained from J. B. Lippincott & Co., and are after cuts in Saunder's Insects Injurious to Fruits.

Mr. F. P. Briggs, as Assistant, has rendered efficient aid in conducting germination tests, looking after the grass plots, conducting spraying experiments and collecting material for the herbarium. Hereafter the experiments with insecticides will be under the direction of Prof. Munson and any one wishing information on spraying apparatus or insecticides should address their letters to him. Those who wish information regarding plants or insects, especially injurious fungi or insects are requested to sent specimens to the writer. Directions for sending specimens may be found in Station Report, 1888, p. 194, or in Maine Agricultural Report, 1888, p. 158.

We invite correspondence. It is to the interest of farmers to cultivate the habit of noticing insects and fungi when they first make their appearance and not wait until pests are beyond control before reporting them. It will be largely through correspondence that the Station learns of insects doing damage in the State.

GERMINATION EXPERIMENTS.

The seeds tested during the year were germinated as in previous years, in pockets or folds of cloth, which were kept moist by a flap of the cloth dipping into water. The entire apparatus was described in the Annual Report for 1888. The conditions, it is believed, were as favorable as possible, and the results obtained seem to prove that such was the case, for in many instances every seed sprouted.

The material for this year's work was obtained from James J. H. Gregory, Marblehead, Mass., and E. W. Burbank, Fryeburg, Me. Following are tables showing the results of the experiments :

RESULTS OF GERMINATION TESTS.

Serial number.	Station number.	DESCRIPTION.	Weight of 100 seeds in grams.	Number of seeds sprouted each day.													Per cent. Sprouted.	No. of days required for one-half to sprout.
				1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	
		GREGORY.																
310	324	Refugee Bean	31.770	0	0	10	40	27	2	0	0	0	0	0	0	0	0	79	4
311	325	Marrowfat Pea	38.706	0	0	9	60	31	0	0	0	0	0	0	0	0	0	100	4
312	326	Field Corn	30.676	0	3	22	52	16	1	0	0	0	0	0	0	0	0	94	4
313	327	Sugar Pumpkin	15.173	0	0	0	12	18	8	2	0	1	0	1	0	0	0	42	
314	328	Imperial Barley	2.962	75	15	5	0	0	1	0	0	0	0	0	0	0	0	96	1
315	329	Saskatchewan Wheat	2.892	40	40	9	2	2	0	1	0	0	0	0	0	0	0	94	2
316	330	Race horse Oats	2.672	10	67	19	0	0	1	0	0	0	0	0	0	0	0	97	2
317	331	Spring Rye	2.034	90	3	1	0	0	0	0	0	0	0	0	0	0	0	94	1
318	332	German Millet	.210	86	3	3	1	1	1	0	0	0	0	0	0	0	0	95	1
319	333	Eclipse Turnip Beet	1.427	5	17	11	1	3	2	0	0	0	0	1	0	0	0	40	
320	334	Hollow Crown Parsnip	.435	0	0	0	1	9	7	8	0	2	3	2	3	0	0	35	
321	335	All Seasons Cabbage	.394	3	23	9	3	1	2	2	1	0	1	0	1	0	0	46	
322	336	White spine Cucumber	2.808	25	65	3	2	0	2	0	0	1	1	1	0	0	0	100	2
323	337	Danvers Carrot	.122	0	5	16	12	5	0	2	2	0	1	0	0	0	0	43	
324	338	Long Scarlet Radish	1.362	31	24	5	4	7	1	1	0	1	1	0	0	0	0	75	2
325	339	Paragon Tomato	.335	0	2	40	20	10	4	0	0	0	0	0	0	0	0	76	4
326	340	Hanson Lettuce	.127	72	18	10	0	0	0	0	0	0	0	0	0	0	0	100	1
327	341	White Dutch Turnip	.213	97	0	0	1	0	0	0	0	0	0	0	0	0	0	98	1
328	342	Yellow Danvers Onion	.345	8	40	17	3	5	3	0	0	0	2	0	0	0	0	77	3
329	343	White Solid Celery	.046	0	0	0	0	3	8	5	2	5	2	1	1	0	0	27	
330	344	Alfalfa	.202	35	10	5	1	1	0	1	0	0	0	0	0	0	0	53	3
331	345	Red Clover	.156	62	20	3	1	1	0	0	0	0	0	0	0	0	0	87	1
332	346	White Clover	.061	25	20	3	18	1	0	0	0	0	0	0	0	0	0	67	4
333	347	Orchard Grass	.075	0	1	10	11	11	10	4	3	4	3	1	2	0	0	60	8
334	348	Timothy	.037	0	70	19	3	0	0	0	0	0	0	0	0	0	0	92	2

RESULTS OF GERMINATION TESTS.—(Continued.)

Serial number.	Station number.	DESCRIPTION.	Weight of 100 seeds in grams.	Number of seeds sprouted each day.													Per cent. sprouted.	No. of days required for one-half to sprout.
				1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	
		BURBANK.																
335	349	Sweet Corn	24.248	0	0	0	4	9	24	40	12	1	1	0	1	0	0	92	4-5
336	350	Turnip Beet	2.240	0	0	0	7	30	15	8	6	3	1	1	0	0	0	71	3-4
337	351	Sibley Squash	14.415	0	0	5	32	3	0	0	2	1	0	0	0	0	0	43	4-5
338	352	Long Green Cucumber	2.705	0	0	17	20	32	1	0	2	0	0	0	0	0	0	72	3-4
339	353	Phinney's Watermelon	9.214	0	0	0	0	2	6	60	10	0	0	0	0	0	0	78	5-6
340	354	Fottler's Cabbage	.412	0	30	56	2	1	0	0	0	0	0	0	0	0	0	89	2-3
341	355	Improved Carrot	.123	0	0	3	8	32	8	4	0	0	0	0	1	0	0	56	3-4
342	356	Purple Top Turnip	.312	9	90	1	0	0	0	0	0	0	0	0	0	0	0	100	1-2
343	357	Hollow Crown Parsnip	.442	0	0	0	0	1	4	10	6	1	3	5	0	0	0	30	8-9

Comparison of Seeds Tested.

During the years 1888, 1889 and 1890, we have tested seeds grown and sold in the State, and also some of those sold in Maine on commission, which are grown in other states. The results have been published in the Reports for these years respectively, but for the purpose of comparison we give below a rèsumè of the larger part of the work. The seeds tested were put up by the following parties: Lewis Atwood, Winterport, Me.; E. W. Burbank, Fryeburg, Me.; Edwin Chick & Co., Bangor, Me.; Department Agriculture, Washington, D. C.; A. H. Dunlap & Sons, Nashua, N. H.; R. B. Dunning & Co., Bangor, Me.; Thos. W. Emerson & Co., Boston, Mass.; D. M. Ferry & Co., Detroit, Mich.; James J. H. Gregory, Marblehead, Mass.; Kendall & Whitney, Portland, Me.; David Landreth & Sons, Philadelphia, Pa.; E. W. Lyman, Springfield, Mass.; Delano Moore, Presque Isle, Me.; J. B. Rice, Cambridge, N. Y.; James M. Thorburn & Co., New York, N. Y.

Put up by	Varieties tested.	Average % sprouted.	Put up by	Varieties tested.	Average % sprouted
Lettuce.			*Lettuce.*		
Atwood.	2	63	Emerson.	1	10
Chick.	1	99	Ferry.	2	90
Dept. Agr.	2	90	Gregory.	1	100
Dunlap.	3	83	Lyman.	1	0
Dunning.	1	77	Rice.	3	71
Turnip.			*Turnip.*		
Atwood.	3	73	Ferry.	5	83
Burbank.	1	100	Gregory.	1	98
Chick.	1	76	Lyman.	1	4
Dunlap.	3	29	Moore.	1	99
Dunning.	1	29	Rice.	2	73
Emerson.	1	97			
Cabbage.			*Cabbage.*		
Atwood.	1	48	Emerson.	1	92
Burbank.	1	89	Ferry.	4	85
Chick.	1	69	Gregory.	1	46
Dept. Agr.	4	80	Lyman.	1	91
Dunlap.	3	49	Rice.	3	77
Dunning.	1	88			
Parsnip.			*Parsnip.*		
Atwood.	2	22	Ferry.	3	55
Burbank.	1	30	Gregory.	1	35
Chick.	1	44	Lyman.	1	0
Dunlap.	5	36	Moore.	1	82
Dunning.	1	34	Rice.	2	58
Emerson.	1	49			

Put up by	Varieties tested.	Average % sprouted.	Put up by	Varieties tested.	Average % sprouted.
Celery.			*Celery.*		
Atwood.	1	58	Ferry.	2	35
Chick.	1	27	Gregory.	1	27
Dunlap.	1	10	Lyman.	1	33
Dunning.	1	62	Rice.	2	45
Onion.			*Onion.*		
Atwood.	1	73	Ferry.	1	67
Chick.	1	74	Gregory.	1	78
Dept. Agr.	10	83	Lyman.	1	0
Dunlap.	4	34	Rice.	2	87
Emerson.	1	95	Dunning.	1	62
Beet.			*Beet.*		
Atwood.	2	52	Emerson.	1	77
Burbank.	1	71	Ferry.	3	83
Chick.	1	63	Gregory.	2	60
Dept. Agr.	6	76	Lyman.	1	48
Dunlap.	4	79	Moore.	1	84
Dunning.	1	18	Rice.	4	72
Carrot.			*Carrot.*		
Atwood.	1	57	Ferry.	2	58
Burbank.	1	56	Gregory.	1	43
Dunlap.	2	56	Moore.	2	82
Dunning.	1	51	Lyman.	1	22
Emerson.	1	48	Rice.	2	45
Tomato.			*Tomato.*		
Atwood.	2	52	Gregory.	1	76
Dept. Agr.	4	58	Lyman.	1	57
Dunlap.	1	78	Rice.	3	91
Ferry.	2	81			
Radish.			*Radish.*		
Atwood.	2	4	Gregory.	1	75
Dunlap,	2	79	Lyman.	1	80
Ferry.	2	69	Rice.	3	84
Sweet Corn.			*Sweet Corn.*		
Burbank.	2	95	Gregory.	1	94
Dept. Agr.	2	82	Moore.	1	90
Ferry.	1	99	Rice.	3	86
Clover.			*Clover.*		
Chick.	3	86	Landreth.	1	78
Dunning.	4	88	Moore.	1	81
Gregory.	2	77	Thorburn.	5	86
Kend. & Whit.	5	83			

Experiments with Corrosive Sublimate.

In all of the germination experiments care has been taken to destroy all fungoid germs by boiling the cloths used, for about thirty minutes, and thoroughly scalding the tray and everything connected with it. Yet the seeds have moulded more or less during the two weeks they remained in the germinator. Those that sprouted in a few days moulded but little, or not at all, while those that sprouted slowly, or failed to germinate moulded considerably, and sometimes very badly. The germs of the mould must in these cases have been on or in the seeds themselves. The question arose whether the mould interfered in any way with the

sprouting of the seeds. As was stated in last year's report, a weak solution of corrosive sublimate, (mercuric chloride) one part to ten thousand parts of water was used, in which the seeds were dipped, after which they were washed in water that had been boiled, and then placed in the germinator. Only a few were tried in this way and no conclusions could be safely drawn from the results. This year more experiments were made, in about the same way. Two solutions were used each stronger than the first, one having one part of the corrosive sublimate to one thousand parts water, and the other, one part to five hundred parts water. Below are tables showing the per cent. sprouted, with and without being dipped in the solutions.

Corrosive sublimate 1 part to 1000 water			Corrosive sublimate 1 part to 500 parts water.		
Kind of seed.	Not treated.	Dipped in solution.	Kind of seed.	Not treated.	Dipped in solution.
Bean.	79	79	Corn.	92	88
Parsnip.	35	37	Beet.	71	31
Cabbage.	46	43	Squash.	43	25
Carrot.	43	50	Cucumber.	72	67
Radish.	75	78	Watermelon.	78	78
Tomato.	76	82	Cabbage.	89	82
Celery.	27	7	Carrot.	47	56
Alfalfa.	53	58	Turnip.	100	100
Red Clover.	87	89	Parsnip.	30	3

One thing is proven by these experiments, that in some cases at least, the sublimate did not injure the vitality of the seeds, and in no case did it destroy *all* of the seeds, if it affected them in any way. The average of the two columns is nearly the same. Those that vary the most have the lowest percentage, while those that average above seventy-five per cent. differ but little. Another thing is sure, that the sublimate destroys the germs of the fungus. None moulded after being treated, except the squash, and that but little, while before being dipped it was completely covered with a dense forest of fungus. And yet, more squash seeds sprouted when they were not treated with the solution. This makes it impossible to say at present whether it is of any advantage to use the sublimate solution. In seven cases out of the eighteen, more germinated when it was used. In eight cases, more when it was not used, and in three instances there was no difference. Till more data is obtained all we can assert is that a solution of corrosive sublimate of proper strength will destroy the germs of mould without destroying the vitality of the seeds, and probably without injuring them.

Experiments with Grasses.

In Experiment Station Report, 1889, p. 161, will be found a consideration of forage plants tested on small plots to determine their adaptability to the soil and climate of Maine. On page 169 of the same Report is a table of the most promising ones. Of these, eleven kinds were selected the past season and grown in one-eight acre plots, and next season a record will be kept regarding them.

SPRAYING EXPERIMENTS.

Apple Scab.

It was intended to conduct some spraying experiments the past season with copper compounds, to determine their value in preventing or checking apple scab. For various reasons mentioned below the work was abandoned. Arrangements were made with Mr. F. M. Woodward, Winthrop; Mr. Chas. S. Pope, Manchester, and Mr. E. F. Purrington, Farmington, to conduct these experiments. The material for the work at Winthrop was ordered early, but by delay in transportation did not reach its destination in time to make the first application before the leaves started. The bloom was so light and the rains so heavy and frequent it was thought best to abandon the work for the season. Mr. Pope writes that he made the first application but a heavy shower washed it off almost immediately, and as the rainy weather continued he did not spray again. One of the difficulties in using these compounds is that they are washed off by rains and the disease is always worse in rainy seasons. The copper compounds are quite rapid in their action upon vegetable spores and would destroy them in a few days. Much good would therefore be done if the compounds remained only a few days before being washed off. Care should be taken to make the applications immediately after showers. These experiments will be conducted another season if possible. The experiments conducted by Prof. Taft in Michigan, and Prof. Goff in Wisconsin, in 1890, and considered in Me. Expt. Sta. Rept., 1889, p. 182, indicate that the copper compounds will materially check this disease and at a very small cost. We would like to see

the method carefully tested in Maine and hope many will spray for the scab another season and report the results. Directions for spraying and apparatus were considered in the Station Report for 1889. Additional information if needed will be given by correspondence.

Codling Moths.

Complaints of Codling Moth ravages continue to be reported to the Station. It is a surprise that the arsenic compounds are not used to check this pest. It is conceded by many fruit growers in other states, who have tried spraying with Paris Green and London Purple for codling moths, that they are effective remedies. Why do not the orchardists of Maine avail themselves of this remedy? The process is simple, free from danger, effective and the materials and apparatus inexpensive in relation to the benefits received. In the interests of successful orcharding in Maine may we not strongly urge the great importance of spraying? In our Report for 1889 it was suggested that perhaps the first application should not be made until the apples are larger then peas. This is based upon the belief that the moths come out later in Maine, than has been supposed. We hope those who spray will watch the first appearance of the moths about the trees and report the same to the Station.

EXPERIMENT WITH PARIS GREEN UPON POTATO BEETLES.

It is well known by those who use Paris Green to destroy Potato Beetles, that there is more or less difficulty in obtaining a mixture of the right strength to kill all the insects, without "scorching" the leaves.

In order to determine the least amount of Paris Green required to do effectual work, four different strengths were used. The amounts taken were one and one-half, one, one-half and one-fourth teaspoonful to two gallons of water. As a teaspoonful weighs very nearly 8 grams, and there are 454 grams in 1 pound avoirdupois it would be at the rate of 1 pound Paris Green to about 75, 112, 125, and 250 gallons of water respectively. The poison was applied to four adjacent rows, all being badly infested with young beetles. There was no rain at the time, or any thing

to interfere with the experiments so far as is known. After thirty-six hours the results were noted as follows:

First row, one and one-half teaspoonfuls to 2 gallons water, nearly all the insects killed.

Second row, one teaspoonful to 2 gallons water, same as first, so far as one could perceive.

Third row, one-half teaspoonful to 2 gallons water, perhaps one-half the beetles dead.

Fourth row, one-fourth teaspoonful to 2 gallons water, could only find an occasional one dead.

The leaves were not scorched in any of the rows.

From these experiments we see that one teaspoonful of Paris Green to 2 gallons of water, or at the rate of 1 pound to 112 gallons, did as effectual work as the stronger mixture, while the lesser amounts were not sufficient. This is perhaps as good a rule as can be given, and the amount may be varied more or less, if the strength of the Paris Green is found to vary.

CAUSES OF POTATO SCAB.

Since my last Report some very important investigations into the cause of Potato Scab have been made at the Indiana Experiment Station by Mr. H. L. Bolley and at the Connecticut Station by Dr. Roland Thaxter. Though there were differences of opinion, botanists had about concluded that this disease was due to chemical or mechanical conditions and not to a vegetable or animal parasite, but the investigations of these gentlemen have opened the question anew. They claim to have discovered specific forms of organisms that will when introduced into healthy potato tubers produce the scab, and wherever the disease occurs these organisms are present. It is exceedingly interesting to know that the species of bacterium found by Mr. Bolley, and regarded by him as the cause of the disease, is entirely different from the filamentous fungus found by Dr. Thaxter. It is reasonable to conclude as is done by Dr. Thaxter that there are two kinds of Potato Scab, the organism studied by Mr. Bolley producing what is called *shallow* or *surface scab* and the one found by Dr. Thaxter causing the *deep scab*. The investigations of these gentlemen seem so thorough it is hard to find any errors in their work and the conclusions reached seem inevitable. Now that the parasitic

nature of the disease is established the theories of mechanical and chemical irritation, insect depredations, excess of moisture in the soil, and the attacks of larger fungi must be discarded as *primary* causes. It is well established by many observers and many experiments, that rubbish, garbage, excess of vegetable matter, fresh stable manure, saw dust, chip manure, ashes and lime, excessive moisture in the soil and growing potatoes from year to year on the same field aggravate the disease. It is therefore certain, that the agents and conditions before regarded as *primary* causes are secondary, aggravating the disease by producing conditions favorable to the growth of the parasites. The investigations of Dr. Thaxter indicate that the fungus causing the disease may be a form common in manure and other fermenting organic matter and would be transferred to the soil in such material and reach the potato tubers. Should this prove to be true it would open the question how far diseases affecting farm crops are due to the germs carried to the field in infested fertilizers and lead to the necessity of adopting means to sterilize fertilizers. Certainly it would do but little good to select clean potatoes for seed and plant them in a soil fertilized by material teeming with the organism that causes potato scab. If the disease is caused by vegetable parasites, as seems quite probable, then scabby seed and infested fertilizers are the sources of the disease, or the germs may live in the soil over winter. By selecting clean seed and not planting successive seasons on the same ground, two of the sources would be eliminated. This would leave the fertilizing material as the remaining source of infection.

It would also be necessary to avoid all general conditions as poorly drained soil, etc., that are known to favor the development of fungi.

Although neither Mr. Bolley nor Dr. Thaxter have suggested any definite remedies, it is a long stride in the right direction to know the cause of a disease, and as Mr. Bolley says, "The facts secured must of necessity affect the future investigations in the line of prevention; and the indications are very favorable to the belief that results in that direction may be reached which will have a financial value to the potato grower." Those who wish to read the investigations of Mr. Bolley and Dr. Thaxter will find articles by the former in Agric. Science, Knoxville, Tenn., September and October, 1890 and by the latter in Conn. Exp't. Station Bull. No. 105, Dec. 1890.

Since the above was written Prof. Thaxter has been successful

in producing the scab disease by inoculating healthy tubers with the fungus, but thinks the similar fungus found in horse dung will not produce it.

STRAWBERRIES.

The following correspondence regarding strawberries may be of sufficient interest to place on record.

After receiving Mr. Fowler's letter the writer asked Prof. Maynard, of Amherst, Mass., some questions regarding strawberries and below his answer is given, also Mr. Fowler's letters. The facts contained therein may be suggestive to others who are growing strawberries. The Station is testing varieties of strawberries (see Ex. Sta. Rept. 1889, p. 256) which will be reported upon in the future.

SEARSMONT, ME., Aug. 27, 1890.

PROF. F. L. HARVEY:

Dear Sir:—I wish some information in regard to strawberries. My patch looks very nice and I expected a nice yield but they were small and *ill shaped*. I think the most of them are Crescent seedlings and am afraid there are not enough Wilsons. What I wish to know is this, will natives do to set out with the Crescent seedlings next spring?

Very truly,

M. A. FOWLER.

AMHERST, MASS., Sept. 22, 1890.

PROF. F. L. HARVEY:

We have discarded both the Crescent and Wilson, but they are suitable to grow together as the one is about as poor as the other. I do not know how the last succeeds with you, but with us it is worthless on account of its lack of vigor. The Crescent is vigorous and productive but poor quality. Would advise the trial of Bubach No. 5 in place of the Wilson, and if you find the Crescent valuable perhaps the May King, Warfield or Haviland would please you as a fertilizer for both. It would be far more profitable to set some other variety than the wild seedling to fertilize the Crescent unless you wish to save the seed, in which case it might give some interesting crosses.

Very truly yours,

S. T. MAYNARD.

Searsmont, Me., Oct. 28th, 1890.

Prof. F. L. Harvey:

Dear Sir:—As to my strawberries I am in a fix. I must have some 15,000 plants and I can't get enough of any variety but natives to set out, so shall be compelled to set them or none. The berries formed this year and some grew well, also had some Wilson berries among them, but most of the berries were ill shaped, small and did not ripen good or refused to grow larger than a Champion of England pea. I gave them a heavy coating of manure in August and cultivated it in with spring tooth cultivator and now have an abundance of nice plants. Expect to get some Haviland or some other variety in the Spring to set out for sets the next year. My plants were hurt last winter and spring by ice and rain.

Very truly,

M. A. Fowler.

Rib Grass or English Plantain. *(Plantago lanceolata, L.)*

Kate Furbish, Del.

RIB GRASS, OR ENGLISH PLAINTAIN.

Plantago lanceolata, L.

This weed belongs to the Order *Plantaginaceæ* (Plantain Family) and was introduced from Europe. *Plantago* comes from the Latin and means *sole of the foot*. It was originally applied to the door yard plantain, which grows in foot paths. *Lanceolata* refers to the lance shaped leaves. It may be known by the following description:

Root living from year to year, stem grooved, angular, nine inches to two feet high; leaves hairy, narrow, three to five ribbed and in a cluster at the root. The flowers small, whitish, borne in a thick short spike at the end of the long flower scape. The pod opens at the top by means of a lid and allows the two oblong boat shaped seeds to escape. These seeds are smaller than clover seed and may be distinguished by the brownish color, oblong shape and hollow or groove on the inner face. They look like a diminutive boat. Attention is especially directed to this weed, as it is being introduced into the State in clover seed. Complaints have been received about fields over run with it, that were seeded to clover. The seeds of the plaintain being smaller and duller colored are liable to escape notice, being hidden by the bright yellow color of the clover seed. Great care should be exercised by farmers in purchasing clover seed, so as not to introduce this detestable weed. We hear complaints of its occurrence in other States. Being a perennial it is a hard weed to exterminate. It is hardy and will cover the ground with a mat of leaves. Cultivation in a hoed crop would be the best way to control it.

Accompanying the Report for 1889 was an envelope containing New York Red Clover seed, adulterated with about ten per cent. of Rib Grass seed, (*Plantago lanceolata, L.*) This seed was purchased at a prominent seed store in Maine and was highly recommended. It was distribubted that farmers might learn to distinguish the seed of Rib Grass and avoid it.

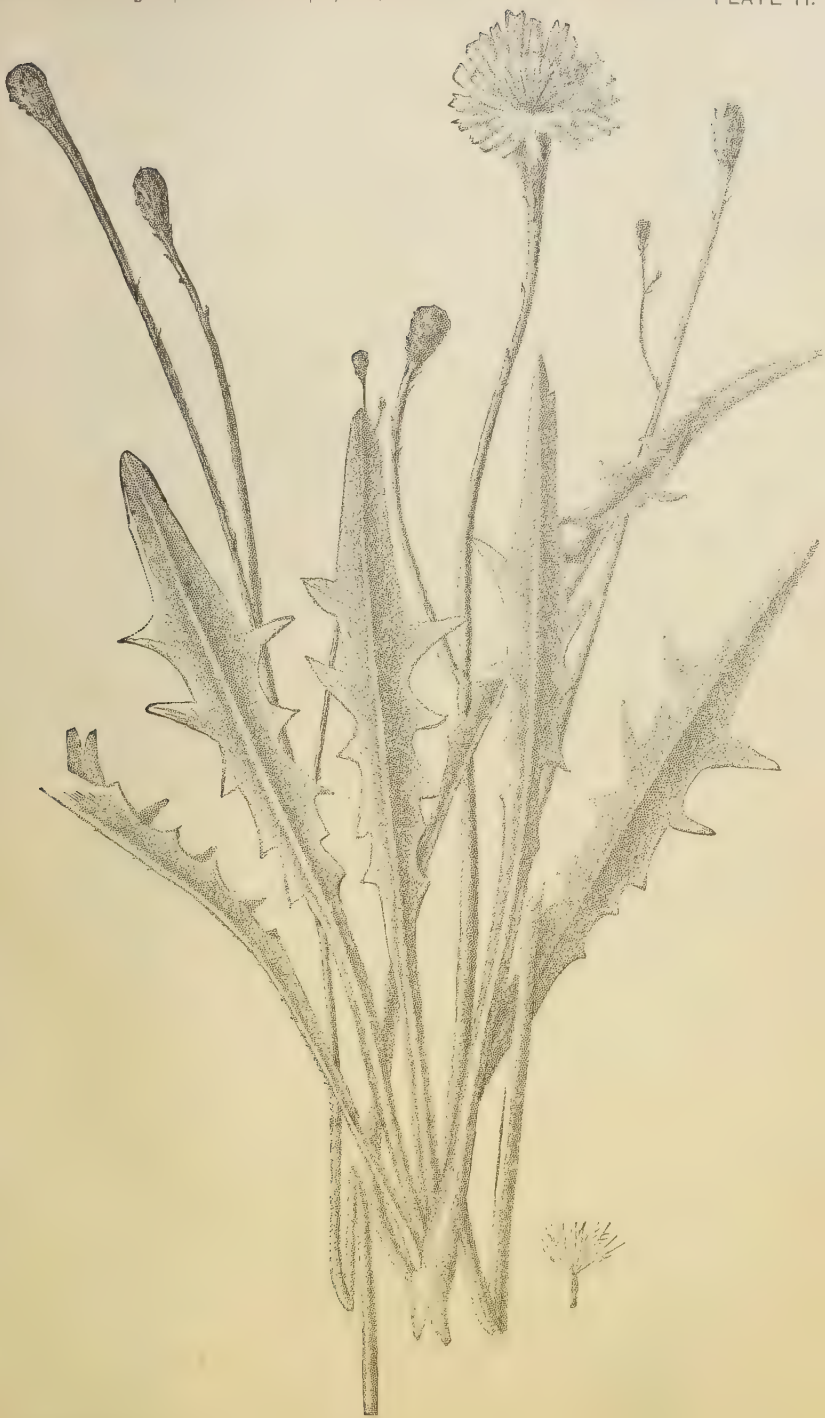
That farmers may recognize this weed when they see it growing, we publish on the opposite page a fine crayon drawing made by Miss Kate Furbish, Brunswick, Me. The plate also shows one of the flowers, and one of the stamens enlarged.

FALL DANDELION.

Leontodon autumnalis, L.

This plant belongs to the Order *Compositæ* or Sunflower Family and was introduced from Europe. The genus name *Leontodon* comes from two Greek words and means lion-toothed, referring to the toothed leaves. The specific name *autumnalis*, means blooming in the autumn, but is hardly applicable to this plant as it blooms from June to November. This weed can be readily determined by the following description: the plant from five inches to two feet high; branched and bearing heads at the ends of the scaly thickened branches, which are composed of many yellow strap shaped flowers. Leaves clustered at the root, lance shaped, hairy and cut toothed. Perennial, growing in meadows and along roadsides, and blooming from June to November. It has spread from New England to Arkansas. Where found along roadsides it should be dug up. The seeds, which bear at one end a row of tawny brittles, (*pappus*) are easily carried by the wind to cultivated grounds. When introduced, cultivation in a hoed crop is the best way to kill it.

On the opposite page is shown a fine cut of this weed made from a crayon drawing executed by Miss Kate Furbish, Brunswick, Me. This will enable farmers to tell the plant when they see it. The plate shows the plant natural size and also one of the seeds magnified and with the bristles (pappus) attached at the end.



FALL DANDELION. *(Leontodon autumnalis, L.)*

KATE FURBISH, Del.

THE CECROPIA EMPEROR MOTH.

Platysamia Cecropia, (*Linn.*)

We received a cocoon of the above insect from Mr. R. C. Higgins, attached to a Juniper twig. The cocoon was put away and on June 10th the moth came forth, and essentially the following letter was sent to Mr. Higgins, which may be of interest to others:

"Dear Sir:—The cocoon you sent some weeks ago produced to-day a beautiful moth (five and a half inches spread of wing) known as the Cecropia Emperor Moth. This insect belongs to the *Bombycidæ* which embraces the Chinese silk worm *Bomby mori*. It is the largest species of moth found in the United States. It usually feeds upon the apple, plum and cherry and a variety of other shrubs and trees. Taking it upon a Juniper is novel to me, and I find no record of it feeding upon coniferous plants. The caterpillar probably wandered to the Juniper tree to spin its cocoon. This insect is not abundant in nature and though classed as one of the pests of the orchard does but little damage. It is kept in check by ichneumons, other insect parasites and birds.

The moth, caterpillar and cocoon of this insect all being so large and conspicuous they attract attention and specimens are frequently sent. The *moths* may be known by their large size, the rich brown color of the wings, each bearing near the middle a kidney shaped white spot usually shaded with red and edged with black. The *caterpillars* are three or four inches long and nearly as thick as a man's thumb; pale green with carrot red warts on the third and fourth segments of the body, yellow warts upon the back of the other segments, excepting the second and last, on which they are blue, as well as the smaller warts along the sides.

The *cocoons* are about three inches long, pod shaped, rusty gray or brown, and firmly attached by one side to a limb. They are composed of two layers of silk, an outer papery and loose fibrous one and an inner densely woven oval one containing the chrysalis. The moths come from the cocoons in June. The eggs are soon laid and in a week or ten days the caterpillars appear. They are voracious feeders. When full grown in the fall they

spin their cocoons and remain in this state until the following spring. The cocoons are frequently found in the orchard or woods after the leaves have fallen, attached to the branches.

This moth is considered in Saunder's *Insects Injurious to Fruits*, p. 73, and all the stages figured. It is also considered in *Insects Injurious to Vegetation*, Harris, pp. 385-388.

THE WHITE-MARKED TUSSOCK-MOTH.

Orgyia leucostigma, (Sm. & Abb.).

During the past two years specimens of the above insect, in the egg, larval and wingless female stages of its life history have been received at the Station from various parts of the State. Being apparently widely distributed and having attracted considerable attention we give below an account of its habits.

Eggs, three or four hundred in a mass attached to the empty grayish cocoon previously occupied by the female moth. Egg mass convex, smooth, grayish white; composed of several layers of eggs with a frothy, gelatinous material between them.

Larva, when mature, over one inch long; bright yellow; head and two small protuberances on the back carrot red; back ornamented with four cream colored brush like tufts; two long black plumes near the head and one near the posterior end of the body; sides clothed with yellow hairs; brown or black stripe on the back, and a dusky stripe on each side. See Figure 1.

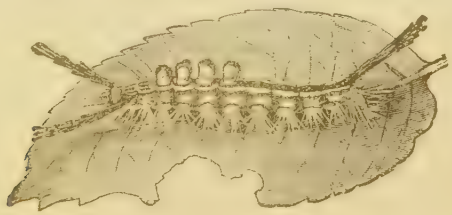


Fig. 1.

Cocoon, gray, spun on the inside of a leaf. Texture loose and the silk interwoven with numerous hairs from the caterpillar.

Chrysalis, enclosed in the cocoon, oval, brown or sometimes whitish below, covered with whitish hairs or down. Figure 2 d. shows the male chrysalis and Figure 2 c. the female chrysalis.

Perfect Insect (female) wingless or wings mere rudiments, light gray, oblong oval, body distended with eggs; legs long. Figure 3 represents the female resting upon the empty cocoon from which she emerged.

Perfect Insect (male) winged, expands an inch and a quarter, fore wings crossed by wavy bands of darker shade; a small black spot on the outer edge of the wing toward the tip, beyond it an oblique blackish stripe, near the outer hind angle a minute white crescent. Body gray with a small black tuft near the base of the abdomen, antennæ feathered. Figure 4 represents the male moth natural size.

Fig. 2.

Fig. 3.

Fig. 4.

Life History.

During the winter months there will be found occasionally in the orchard, dead leaves attached to the branches of the trees. Upon examination these will usually be found to contain an empty, gray cocoon with a mass of eggs attached to it, as described above. These eggs hatch in Maine about the first of June or earlier farther south. The young larvæ at once begin to devour the leaves of the tree. When disturbed they lower themselves by means of a silken thread which they climb when danger is past. The beautiful caterpillars described above feed about two months and then spin their cocoons. The moths soon emerge and the females being little more than animated masses of eggs are sluggish. The males having wings are able to fly and they meet the females while resting upon the empty cocoon to which the mass of eggs is finally attached. The eggs soon hatch, producing the *second* brood of caterpillars which complete their growth late in the season and enter the chrysalis state. The

moths soon emerge, mate. and the eggs are deposited and remain on the trees during the winter.

REMEDIES.

The female is wingless and always attaches her eggs to her empty cocoon, hence the insect does not readily spread from tree to tree. The caterpillars sometimes wander when their food supply is gone, or are accidently carried from tree to tree, or eggs are introduced on young trees. From the nature of the insect it it is not usually very injurious but sometimes does great damage to the leaves of apple trees and also gnaws the surface of the fruit. Though partial to the apple tree it also feeds on the plum, pear cherry, rose, and occasionally on the elm, maple, horse chestnut, linden, oak, locust, butternut, black walnut, hickory, spruce, fir, larch and other plants. The orchard should be examined during the winter months for leaves attached to the branches and if they contain egg clusters collect and *burn* them. Any cocoons without egg clusters should not be molested, as they probably contain parasites of this pest and should be protected. Mr. Saunders says that nine different species of parasites, four and two winged flies, are known to prey upon this insect in the caterpillar state.

THE FALL WEB-WORM.

Hyphantria cunea, Drury. (H. textor, Harris.)

While in Cumberland County, Me. last season attention was directed to an orchard badly infested by this insect. Though it was only July 5th, the webs were already quite conspicuous. In *Forest Insects*, just issued from the Dept. of Agric., Dr. Packard, on p. 244 says: "The name *Fall Web-Worm* is most expressive for New England and other northern states where the insect is single brooded, appearing there during August and September, while in more southern regions it is double brooded." Though we have not traced this insect through its life history in Maine and cannot *positively* say there are two broods, yet the fact that the webs were conspicuous and the larvæ fully three-fourths of an inch long early in July would indicate two broods in western Maine. A few webs were observed about Orono during the fall months, probably those of the second brood or late single brood.

This is a native insect which has from time to time done great damage to forest and fruit trees. It is a general feeder, having

been observed to feed upon over one hundred different species of trees, shrubs and herbs. This species makes a web which is sometimes very conspicuous, attaining dimensions of several feet. The web can readily be told from that of the Apple-tree Tent-caterpillar. The *former* insect does not leave the nest to feed. As soon as hatched the young larvæ spin a small web for themselves. Under the shelter of this they feed in company upon the upper portions of the leaf, leaving the veins and lower surface. As they grow they connect their web to adjoining twigs and leaves until finally a whole branch several feet long may be inclosed. The web of the *latter* is more frequently made in the fork and is not usually extended along the branches and the caterpillars leave the nest to feed, returning for the night and to rest. Below is given an account of the insect in all the stages of its life history.

Egg 4 mm. (.16 in.) in length, bright golden yellow, globular, ornamented with numerous regular pits, which according to Packard give it under the magnifying lens the appearance of a beautiful golden thimble.

Larva (young) pale yellow with two rows of black marks along the body, a black head and sparse hairs.

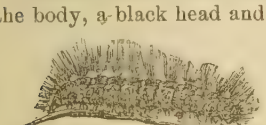


Fig. 5.

Full grown larva usually pale yellowish or greenish with a broad, dark stripe along the back and a yellowish stripe along the side, covered with whitish hairs that spring from black and orange yellow warts. The caterpillars are somewhat variable as to depth of color and marking, even on the same tree. The fall brood is generally darker colored than the spring brood. The larva is shown in Fig. 5.

Cocoon, thin, almost transparent, composed of a slight web of silk intermixed with a few hairs from the caterpillar, or sometimes mixed with sand when the cocoon is spun in the soil.

Pupa, length 0.60 in.; breadth in the middle at the bulge, 0.23 in.; dark brown, smooth, polished, faintly punctate, and bulged in the middle a little all round.

Fig. 6.

Perfect insect, a moth which varies greatly in size and color. These color varieties have received different names by entomologists but are now reduced to H. cunea, Drury. The most common form is white or slightly fulvous with white wings,

but the wings show variations from pure white to those profusely dotted with black and brown; front thighs tawny yellow, sometimes marked with a large black spot; feet blackish; expanse of wings 1 1-4 to 1 2-3 inches; male moth usually smaller with the antennæ doubly feathered beneath. The antennæ of the female possess two rows of minute teeth. The moth is shown natural size in Fig. 6.

Life History.

The female deposits her eggs in a cluster on the upper or under side of a leaf, usually near the end of a branch. The clusters consist of many eggs laid in regular rows, if the surface of the leaf admits. Sometimes the eggs are laid in smaller irregular patches. Each female lays on an average about five hundred eggs. The eggs for the first brood are deposited by the last of May or during June, and the time required for them to hatch depends upon the weather. Under favorable circumstances they mature in about ten days, or those of the second brood in eight days. As soon as the caterpillars hatch they spin a small silken web which soon becomes conspicuous. Under this they feed together upon the upper surface of the leaves. As they grow other leaves and branches are included until the web reaches considerable size and contains dead leaves and the molt skins of the larvæ. If their food supply gives out they quit the web and drop to the ground and crawl directly toward other trees with almost unerring instinct, or when disturbed let themselves down by a thread and by this regain the tree when the danger is past.

When full grown they are 1.11 inches long and leave the web and wander about for suitable places to spin their cocoons. They select crevices in bark, the angles of tree boxes, rubbish about the base of trees, and other similar situations, while the fall brood prefer to bury themselves in the earth if possible, but adapt themselves to circumstances. They soon spin their cocoons. The pupæ contained in these hatch into the second brood of moths about the first of August, and the moths lay eggs which hatch into caterpillars that feed, mature and spin their cocoons during August and September. The insects invariably spend the winter in the chrysalis state in the cocoon and the following spring the moths emerge and lay their eggs, thus completing the life history.

Remedies.

As these insects do not leave the web to feed and are protected by it, spraying to kill them would do no good. The best way is to strip the webs from the extremities of the branches with the hand as soon as they appear, and destroy them with the included young caterpillars. The twigs bearing the small webs should be cut off with a knife when on the low branches, or with long handled pruning shears if on high branches and burned. These insects should be destroyed while the webs are small. There is no excuse for allowing them to remain until large branches are involved in the web. The webs are unsightly and even when the insects are not abundant enough to do serious damage they should be destroyed.

The natural enemies of this insect are many. Outside of insect parasites and predacious insect enemies, screech owls, cuckoos, the common toad and several species of spiders feed upon them. They have but few bird enemies, being so hairy birds will not eat them. Those mentioned above and the common toad eat the whole insect, while the spiders suck the soft parts out and leave the shell.

Among the predacious insects, the Mantis or rear horse in the south, and the wheel bug and other hemipterous insects in other parts of the country help to hold them in check. The true parasites are those that lay their eggs in the eggs or caterpillars of the web-worm and destroy them. They consist of hymenopterous or ichneumon like insects and tachina flies. Of the former one species infests the eggs, and two others lay their eggs in the caterpillars. One species of tachina at least is known to infest the larvae of the web-worm. The eggs of the parasites hatch and their larvae destroy the web-worm, and from their chrysalids or cocoons the parasites come forth.

THE EYE-SPOTTED BUD-MOTH.

Tmetocera ocellana, (Schiff.).

Fig. 7.

The following letter was received last May:

ROCKLAND, ME., May 20, 1891.

ENTOMOLOGIST EXPERIMENT STATION.

SIR:—I send you some blackberry buds that are infested with maggots. I have about one-fourth of an acre and I think three-fourths of the buds on the piece contain one or more of these maggots. I noticed them for the first time last year, when I found a few of them. When the buds are small they eat into the heart of them and spoil them. The eggs are deposited in the buds early in the spring or in the fall. I have found some of them on rose bushes and also on a peach tree standing near the blackberries. My family and I have killed a great many of them but still they will injure the bushes very much.

Yours respectfully,

JOHN N. INGRAHAM.

The specimens sent by Mr. Ingraham were put into a breeding cage to transform and proved to be the Eye-spotted Bud-moth. This species was considered and figured in the Annual Report of the Experiment Station, 1888, p. 169 and in the Maine Report of Agriculture, 1888 p. 133 as a pest upon apple trees. We find no record of this species attacking blackberries, therefore the habit is new. The observations of Mr. Ingraham would indicate that this species also feeds upon the peach tree and roses. As there are several *bud-moths* that infest our fruit trees and shrubs it is not safe to conclude that this species did the injury on the peach trees and roses, though they were near the blackberries, until the insect has been reared from them. It is not improbable that the Eye-spotted Bud-moth feeds upon peaches and roses, as it is known to feed upon plums and cherries, plants belonging to the same family.

The larvæ we transformed went into the pupa state the last of June and the moths appeared in July. As the moths are on the wing in July the eggs must be laid in the summer or fall, and as the larvæ are apparently nearly grown and have done much damage early in June the eggs must hatch very early or else the larva hybernate. When this insect was considered in 1888 we did not have the writings of Mr. James Fletcher, who expresses the opinion in his Report for 1885, p. 24, as Entomologist to the Dept. of Agric. of Canada, that it passes the winter in the larva state on the branches of apple trees, protected by a covering of silk. Since the above was written there has appeared from the pen of Prof. Fernald in Bull. No. 12, April, 1890, Mass. Expt. Station an interesting article upon this insect.

This article contains such an exhaustive and careful study of the egg and larval stages we quote that portion of it *verbatim*.

"The fore wings expand about three-fifths of an inch. The head, thorax, and basal third of the fore wings, and also the outer edge and fringe are dark ash gray, the middle of the fore wings is cream white, marked more or less with costal streaks of gray, and in some specimens this part is ashy gray, but little lighter than the base. Just before the anal angle are two short horizontal black dashes followed by a vertical streak of lead-blue, and there are three or four similar black dashes before the apex, also followed by a streak of lead-blue.

The hind wings above and below and the abdomen are ashy gray. The under side of the fore wings is darker, and has a series of light costal streaks on the outer part.

The moths pair and the female lays her eggs, when in confinement, in clusters of from four to ten or eleven, often overlapping each other. They are oval, flattened, four-fifths of a millimeter long, and half as wide, sordid white, with a narrow border of clear and transparent white, while the center of the eggs is one complete mass of minute granules. In about three days the center of the egg has grown darker, and the granules larger; and on either side there is a clear, white, oval space about one-third the length of the egg. In about two days more the outer edge of the center is the same color as in the last stage, and inside this is a narrow, lighter band, while in the center is seen the form of a cylindrical larva larger at one end, and both ends slightly curved towards each other; and in one or two days more the whole form of the larva is visible, the head, thoracic and anal

shields being black. The egg stage lasts from eight to eleven days.

When the young larva hatches it does not eat the shell of its egg, but goes on to the tenderest leaves and almost immediately begins spinning a microscopic layer of silk, under which it eats the outer layer or epidermis of the leaf. The larva is then about three millimeters in length, of a creamy white color, with head, thoracic and anal shields blackish brown, and a few minute pale hairs on the body; the head is very large for the rest of the body. In a week the larva is nearly four millimeters long, light yellowish brown, with the head, thoracic and anal shields dark brown, and it eats minute holes through the leaf, its silken web now being visible to the naked eye. The larva gradually becomes a trifle more brownish, increases in size and enlarges its web along the side of the midrib.

Late in the fall the silken web is quite heavy and thick, and the larva deposits its excrements in little black pellets in the form of a tube, under the web, within which it hibernates during the winter. Not unfrequently two leaves are fastened together by the silk of the web, and sometimes a leaf is secured to a branch of the tree in the same manner.

About the first of May the larva measures seven millimeters when resting, and eight when in motion. It is cylindrical in form, with the head dark brown and of medium size. The body is dark yellowish brown, and the head, thoracic and anal shields very dark, polished brown. There are ten lighter brown protuberances on each segment, from each of which arises one pale hair. On the upper surface of the ninth segment is seen the double undeveloped reproductive organ of a light brown color. The legs are dark brown and the prolegs yellowish brown. About the first of June the larva is from ten to twelve millimeters in length, and the body has changed to a cinnamon rufous color. From the middle to the last of June it curls or draws together several leaves which it lines with silk, and in which it transforms to a pupa."

We show in Figure 7, Page 128, a cut of the larva and moth.

Since the above was written Mr. Ingraham writes that though nearly all the buds were infested and badly eaten, the flower buds were not molested and he had a good crop of blackberries. This may have been due to the well known law, that the last effort of nature is to reproduce, and the diminished leaf surface may show

itself next season in a loss of vigor of the new canes. He also writes that this insect was noticed in 1889, but did not do enough damage to attract much attention or require remedial measures. In 1890 it had so much increased as to affect most of the leaf buds. This teaches the important lesson, that orchardists and farmers would save themselves much trouble and expense by carefully watching their orchards and crops to detect new insects when they appear in small numbers, apply remedial measures *at once* and not wait until the entire crop is endangered before active measures are taken. For this reason we urge the importance of sending to the Station for identification insects not known, to learn whether they are friends or foes.

Remedies.

Pick and burn the infested buds while the caterpillars are still in them.

Spray the bushes or trees, about the time the buds are opening, with Paris green, one pound to two hundred gallons of water. London purple could be used instead of Paris green and in the same way. There would be no danger of poisoning the fruit as the application is made so long before the berries are formed it would all be washed off.

If this insect hybernates in its silken web attached to leaves as stated by Prof. Fernald, then to gather the fallen leaves of infested trees or bushes and burn them would seem a good remedy.

THE WOOLLY-LOUSE OF THE APPLE.

Schizoneura lanigera, (Hausm.).

The following letters were received during the fall of 1890:

Wayne, Me., Oct 8, 1890.

Prof. Harvey:

Dear Sir—I send you by to-day's mail a box containing two twigs covered with some kind of a fungous growth. The twigs were taken from a seedling tree set out in the spring of '89, and from the nursery of F. Bowman & Bro., Sidney. The whole top of the tree is affected but otherwise seems healthy. I first discovered it about one week ago. I think I have seen the same growth on black alders. What is it? Is it injurious? If injurious what is the remedy?

Truly yours,

W. A. Burgess.

FAIRFIELD, ME., Sept. 12, 1890.

F. L. HARVEY:

Sir—I can find no more of the worms like those you already have, but I send a specimen which I have lately discovered on a tree which came from Homer N. Chase, Geneva, N. Y. Will write you more at length about them soon.

W. J. HIGGINS.

The specimens accompany the above letters were the "Woolly-louse of the Apple," and as this is quite an injurious insect we consider it at length and illustrate it.

Two forms of this insect are recognized by entomologists. One known as the Apple-root Plant-louse which attacks the roots, producing wart-like excresences or swellings. The other form known as the Wooly-louse of the apple was the one we received. It feeds upon the sap of the trunk and branches. They are regarded as the same species living under different conditions. We do not know which was the original form and which the variety, whether it was a northern species feeding upon the trunk and branches and adapted itself to a southern life by seeking a habitat on the roots, or whether it is naturally a root species seeking the trunk and branches in a cool, moist, northern climate. Its more frequent occurrence on the roots would suggest the latter. The above ground form occurs most abundantly in this country in New England. This insect is more common in Europe and Australia than in America, where it is more destructive, and is called the "American Blight." Entomologists differ in their opinions regarding its nativity, some accredit it to America, most are inclined to think it originated in Europe. It would not be much honor to either country to produce such a pest.

This insect in the root form was noticed in this country as early as 1848, when thousands of trees were found so badly infested that they had to be destroyed. Since then the insect has been reported as doing more or less damage in every section of the country. The above letters indicate that this pest was distributed upon nursery stock, and gives us another opportunity to reiterate the importance of carefully examining nursery stock before setting it.

DESCRIPTION AND HABITS.

Eggs—Minute, requiring a magnifying glass to see them. They are laid in the crevices of the bark at or near the surface of the ground.

The young when first hatched appear like specks of mold, being covered with fine white down. As they get older the cottony covering becomes more distinct, apparently issuing from the pores of the skin of the abdomen and attaining considerable length. The young have beaks longer than the body and when grown this organ is fully two-thirds the length of the body. By means of the beak they attach themselves to the root or branches, and when abundant, draw heavily upon the vitality of the tree, or may even kill it.

When full grown the females are about one-tenth of an inch long, oval, head and feet black, legs and antennæ dusky, abdomen yellowish, body covered with white mealy powder, a tuft of long, easily detached down upon the hinder part. Under each patch of down is usually found a female and her young. During the summer the females are wingless and the young are produced alive. Toward fall the broods contain both winged females and winged males, which have not much down on them and are nearly black and plump. The fore wings are about twice as long as the narrow hind ones. These winged females fly to other trees and lay eggs, establishing new colonies. During the early part of the season this form of the insect is found in clusters about the base of the trunk, upon suckers or twigs springing from the trunk, but in autumn they commonly affect the axils of the leaves and sometimes cover the whole under surface of the limbs and trunk, making the tree look as though whitewashed.

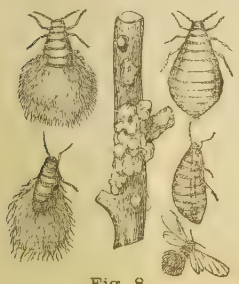


Fig. 8.

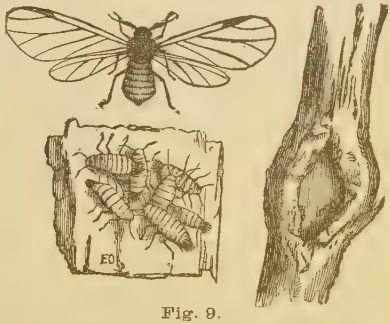


Fig. 9.

Figure 8 shows the insect magnified. The centre of the figure represents a portion of a twig showing how the lice collect about the axils of the leaves.

Figure 9 shows the winged insect much enlarged, a cluster of the young enlarged and an apple twig natural size, showing an opening in the bark caused by the puncture of this insect.

Remedies.

Fig. 10.

Natural remedies.—This louse is preyed upon by a small chalcid fly known as *Aphelinus mali*, Hold, and shown much enlarged in Figure 10. The real size is shown by the crossed lines below. The lady birds and their larvæ, also the larvæ of the lacewing flies and syrphus flies, which feed upon plant lice, also hold this species in check. (A consideration of these useful parasites will be found in Station Report, 1888, under the head of the *Apple-tree Aphis.)* Spiders devour large numbers. They spin their webs over the colonies entrapping them and then devour them at their leisure. We find no record of birds feeding upon them.

Artificial remedies.— The presence of this insect can be readily detected by the moldy or whitewashed appearance of the trunk or branches where the colonies are located. If a tree seems sickly and the leaves turn yellowish, it would be well enough to examine the roots, by laying them bare, to ascertain whether the root form of this species is present. If the lice are found in the crevices, they can be killed by scalding water freely poured upon the roots. If the trees are in the ground the water can be applied nearly boiling without injury. If nursery stock, taken up to transplant, the water should not be hotter than 150° Fahrenheit. The roots may be drenched with strong soapsuds followed by a dressing of ashes on the surface of the ground.

It is said that mulching should precede the treatment, as it causes the lice to come near the surface of the ground where they can be more easily reached. When the lice are on the branches strong soapsuds, kerosene emulsion, or Paris green in water applied in the usual way would prove effective. As the winged females no doubt fly to other trees, more or less, and start new colonies, the lice should be treated before the fall broods appear. It would always be well to carefully examine nursery stock before setting it. At least it should be carefully watched the first season for any new pest that might appear in few numbers, so as to destroy them.

THE RED-HUMPED APPLE-TREE CATERPILLAR.

Œdemasia concinna, (Sm. & Abb.).

This pest of the apple tree has made its appearance in Maine, as shown by the correspondence given below, which is perhaps important enough for permanent record. That the insect may be more easily recognized by orchardists we give Figure 11 an illustration of the moth life size, Figure 12 the full grown larva and Figure 13 the pupa.

Fig. 11.

Fig. 12.

Fig. 13

(For the Maine Farmer.)

Pest of the Apple Trees.

[The following note, together with the box of insects, was sent to Prof. Harvey, of the State College, for his investigation. We give his clear and very satisfactory reply. Ed.]

Mr. Editor:—Please give, through your columns, the history and habits of the pests I send you. I find them stripping the leaves off my apple trees, leaving nothing but the main stem of the leaf. I never saw anything like them before, as I can recollect.

Yours truly,

Fairfield, Me. Wm. J. Higgins.

Editor Maine Farmer:—The insects which you forwarded by express came to hand in good condition. They are the half grown larvæ of the Red-humped Apple-tree Caterpillar; *Œdemasia concinna*, (Sm. & Abb.).

The perfect insect is a moth which measures from an inch to an inch and a quarter across the wings. The fore wings are dark brown on the inner, and grayish on the outer margin. There is a dot near the middle, a spot near the angle and several longitudinal streaks along the hind margin, all dark brown. The body is

light brown, and the thorax of a darker shade. These moths are on the wing late in June or July. The female deposits her eggs on the under side of a leaf in a cluster, usually during July. They soon hatch into small caterpillars. These caterpillars, while young, feed upon the tender tissues of the under side of the leaf, leaving the upper surface unbroken, but when large they devour greedily the whole leaf. They reach maturity during August or September. The specimens sent were about half grown, and were about three-fourths of an inch long. When full grown they are often an inch and a quarter long. The full grown larvæ may be known by the coral-red head and a hump of the same color on the fourth ring or segment from the head. The body is striped lengthwise with narrow yellow, white and black lines. There are two rows of black spines along the back, and rows of shorter black spines on the sides. Each spine bears a fine hair. The spines on the coral-red hump are more prominent than the others. The hinder end of the caterpillar tapers and is usually elevated when the insect is at rest. When handled, a fluid with a strong acid smell is emitted. When mature they descend to the ground and hide under leaves or rubbish, or sometimes burrow a little into the ground and slowly change to the chrysalis state, where they remain until the following spring, when the moths appear, completing the life history. At the north there is only one brood during the summer, but in the south two broods appear.

The species is widely distributed, though not usually abundant. It prefers the apple, but will feed upon the plum, cherry, rose, thorn and pear, plants belonging to the *Rose* family.

As these caterpillars go in flocks, and when not feeding remain close together, they could easily be destroyed by cutting off the branch on which they appear and burning it. They might be destroyed by jarring the limb, and when they fall to the ground trample them with the foot. If the trees are not in bearing, the insects could be destroyed by spraying with Paris green in suspension in water, 1 pound to 150 gallons. They emit such an odor birds do not eat them. It is said that Ichneumons are parasetic upon them and help hold them in check.

This is the first complaint we have had of this insect in Maine. It may have been introduced on nursery stock from farther south. The history of its appearance and the extent of its depredations at Fairfield would be interesting, and we hope Mr. Higgins

will tell us more about it. Those who have a copy of "Saunders" Insect Injurious to Fruits," will find this pest figured and considered on pages 63 and 64.

F. L. HARVEY,

ORONO. Entomologist for the Station.

THE FALL CANKER-WORM.

Anisopteryx pometaria, (Harris.).

This species was considered and illustrated in Station Report, 1888, to which the reader is referred for an account of the life history and remedies. We expressed there a want of information regarding its distribution in the State and damages. Since then we learn it is widely distributed and does considerable damage to the foliage of orchard and shade trees. About Orono it has steadily increased for the past two years and this season did considerable damage. We think that by spraying with Paris green or London purple in the usual way, when the worms are small, they could be readily destroyed. This worm is known by the farmers about Orono as the "Green Inch-worm." Last November we received the following letter, which with the answer, we place on record.

BELFAST, ME., 11, 10, 1890.

F. L. HARVEY:

Enclosed find specimens of Lepidoptera, *Anisopteryx*, I think female, with eggs accompanying. They are to-day found in large numbers on the outside of the front door of my dwelling house in this city.

Are they A. *eseularia* or A. *pometaria*? I was not aware before that they deposited their eggs on buildings. Perhaps they are a new insect. Can you tell?

Haste,

GEO. E. BRACKETT.

MR. GEO. E. BRACKETT:

Dear Sir:—Your letter containing insect specimens was received during my absence from home. It now claims attention. The specimens enclosed are the females and eggs of *Anisopteryx pometaria*, Harris, the Fall Canker-worm. This species usually deposits its eggs upon the branches or twigs of trees. The females being wingless, when they emerge from the ground,

crawl to the base of trees, which they climb. The tendency to climb is so strong in these insects they blindly ascend fences and houses, as well as trees, and deposit their eggs. The eggs thus laid would hatch, but the young larvæ would perish. This shows that the instinct of insects is not the infallible guide claimed by some. They make mistakes in judgment, like us mortals. This species has been abundant here this season. My boys had quite a box of females and eggs which they took upon fence posts during my absence. So this blind habit of laying the eggs seems common, though I have never seen it recorded in any of the entomological works. Will make note of it some time in the future, and give you credit for the observation. Will be pleased to answer questions about insects any time.

Yours truly,

Orono. F. L. Harvey.

THE FOREST TENT-CATERPILLAR.

Clisiocampa sylvatica, Harris.

The Forest Tent-caterpillar was so abundant the past season in several localities in the Penobscot Valley that it caused serious alarm upon the part of many, as to the safety of our forests and orchards. Several articles bearing upon the subject appeared in the local papers. It is no doubt TRUE THAT IT IS a great drain upon the vitality of forest trees to lose their leaves and have to replace them. They probably do not regain their normal vigor for several years and many die from this cause. There is however no need of serious alarm, as the history of this insect shows it does not continue to increase many years in succession, but generally disappears almost entirely after the second season. To ascertain how far parasites were destroying this pest the writer took 135 cocoons last fall and from them was able to rear only twenty moths.

This shows that only about fifteen per cent. survived the attacks of parasites and other mishaps. From the cocoons came forth about ninety parasites; two species of Ichneumons and two species of Tachina flies. As only twenty moths came forth this leaves about twenty-five deaths to be accounted for in some other way. Some of the cocoons seemed affected by a disease, probably bacterial, that may account for part of the mortality. This

spring, 1891 and previously, we have bred a Chalcid fly from the eggs of this species. Thus the efforts of fungi, larval and egg parasites combined aid in holding them in check. The parasites have increased rapidly the past season and there will be comparatively few caterpillars in 1891. The parasites bred were *Pimpla conquisitor*, (Say), *Anomolon* near *exile*, Prov., *Tachina clisiocampa*, Townsend and *Phorocera promiscua*, Townsend.

The Tachinas were new to entomologists and were named and described by Prof. C. H. Tyler Townsend in Psyche for May, 1891. The *Phorocera* was very abundant. Eighty of the one hundred and thirty-five cocoons collected at random were infested by it. This spring we bred from the eggs of this species as stated above, a minute four-winged fly which we sent to Prof. C. V. Riley for identification and received the following reply, which we record for the benefit of entomologists, it being too technical for the comprehension of those not versed in entomology. "The specimen is a species of *Tetrastichus*, a genus in which we have an indefinite number of undescribed species in this country, which are very difficult to separate. Your species is probably undescribed. *Tetrastichus* is invariably, so far as we know, hyper-parasitic and the primary parasite, is, in your case, probably, a Telenomus or a Trichogramma."

FRUIT TESTS.

With few exceptions the plants set in 1889 lived and made a vigorous growth during the season of 1890. In accordance with the purpose noted last year, cions of the most promising varieties of apples were sent to some of the leading orchardists in various parts of the State, for the purpose of determining the adaptability of these varieties to the widely varying conditions existing in different localities. A blank form was sent with all cions that the system of records may be uniform.

The following fruits were added to the experimental plantations in 1890:

APPLES.

Excelsior.
Fall Pippin.
Golden Russet.
Gideon.
Martha.
Mann.
Munson's Sweet.
October.
Peter.
Primate.
Red Russet.
Tallman Sweet.
Vandevere.
Wealthy.
William's Favorite.
White Pippin.
Antononka.
Aport.
Arabskoe.
Bogdanoff.
Early Sweet.
Golden Reinette.
Mallet.
Romna.
Striped Winter.
Table Apple.
Tetofsky.
Titvoka.
Titus Riga.

PEARS.

Anjou.
Angouleme.
Bartlett.
Clairgeau.
Clapp.
Flemish Beauty.
Hardy.
Howell.
Keiffer.
Lawrence.
Le Coute.
Louise Bonne.
Seckel.
Sheldon.
Souvenir des Congres.
Superfine.
Winter Nellis.

PLUMS.

Green Gage.
McLaughlin.
Moore's Arctic.
Quackenbos.
Pond's Seedling.
Prunus Simoni.
Smith's Orleans.
Washington.
Weaver.
Wild Goose.

CHERRIES.

Yellow Spanish.
Black Tartarian.
Belle Magnifique.

GRAPE.

Lindley.

Ent. Xx s

IMP. : :
R - JUN. 1914
ENTOM.

MAINE AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 2.

SECOND SERIES.

THE APPLE MAGGOT.

Trypeta pomonella, Walsh.

PROF. F. L. HARVEY.

(Prof. Harvey has, by nearly two years patient labor, the results of which will appear in a more elaborate and detailed form later, completely worked out the life history of the apple maggot, which is doing such immense injury to fruit in some parts of our State. The practical points of his researches are herewith presented. In securing these results the Station has done its part of the work. The fruit growers must do the rest. If the recommendations which Prof. Harvey makes could be faithfully and universally followed for two years, there would be few traces of the apple maggot left in the State. Concerted and vigorous action on the part of fruit growers is needed.

W. H. JORDAN, Director.)

Last season quite extended and careful observations were made to determine the habits of this troublesome insect and many interesting and novel facts gathered pertaining to its life changes. This summer the studies have been continued and the observations of last season so supplemented and verified that we are now able to announce all the steps in its complete life history. The details of work by which these results were obtained will be fully considered and illustrated in a subsequent bulletin. The object now is to give tersely the steps in the life history of the insect, call

attention to the weak and strong points in its life changes, indicate useless methods of coping with it and suggest such preventive and direct remedial measures as are likely to check its ravages.

LIFE HISTORY.

The *perfect insect* is a two-winged fly somewhat smaller than the house fly.

It was briefly described in the Annual Report of the Experiment Station, 1888, page 175. The figure there given of the female shows the general nature of the fly, though incorrect in some details.

The flies appear in this State early in July and continue to emerge from the ground for about six weeks or two months. They soon begin to deposit eggs in the early apples, which are at that time from one-half to two-thirds grown. The later flies affect the later varieties.

Each female is capable of depositing over 300 eggs, which are inserted from time to time, one in a place, by means of a sharp ovipositor, through the skin of the apple. The maggots hatch in a few days and become full grown in four to six weeks when they are one-fourth inch long. They tunnel or "railroad" the pulp of the apple rendering it worthless.

The larvæ remain in the apples until they are ripe and occur as abundantly in the windfalls as in the hanging fruit. Larvæ of several ages may be found in the same fruit. Soon after they are mature the larvæ leave the apples through characteristic irregular openings in the skin, and if conditions are favorable, go into the ground an inch or less, or on sod ground, they remain about the grass roots. In a short time they change to the pupa state and remain in that condition until the next season when the flies emerge again. There is no evidence whatever of a second brood. The larvæ contained in stored fruit leave it and go into the pupa state in the barrels or bin, and under favorable conditions probably come out the following spring.

REMEDIES.

USELESS METHODS.

1. Spraying early in the season when the apples are small would do no good as the flies are not on the wing until July, when the early fruit is fully half or two-thirds grown, and too large to spray with safety.

2. Though in confinement the flies are very fond of sugar, yet

sweets poisoned with arsenious acid and corrosive sublimate, and placed on paper in shallow pans in the trees, failed to attract them.

3. Sticky fly papers seem to be useless. We exposed several sheets in the branches of a tree where the flies were thick, for three days, and only took a *single* Trypeta fly.

PREVENTIVE MEASURES.

1. Keep the orchards in grass and in the fall or spring burn under the trees to destroy the pupæ that are about the grass roots.

2. If the orchard is in cultivation the conditions are favorable for the maggots to go into the ground, but they never go deeper than an inch and deep spading or plowing in the spring would destroy them.

3. Orchards on sandy soil and in sheltered places with a southern exposure are worse affected. In planting orchards such conditions might be avoided.

4. Prevent by legal enactment the importation of foreign fruit from localities known to be infested. The pest was undoubtedly introduced into the State by importation of foreign apples. And each year there is a new invoice from Mass. in *imported early fruit*. We saw in the Orono market to-day a barrel of early sweet apples from Mass. literally alive with nearly full grown *Trypeta maggots*. No matter what methods are adopted to check this pest they will prove futile if each year in all the towns of the State maggots by the hundreds are thrown upon the ground in worthless infested foreign fruit.

DIRECT METHODS.

1. The flies are very stupid although they appear otherwise. When resting on the leaves or apples they can readily be taken with a small insect tube or bottle. By placing the mouth cautiously over them, they are not disturbed, and soon crawl inside. We took thirty this way from a single tree in an hour and a half. Making no allowance for mishaps and supposing a fly lays three hundred eggs and one-half of the flies are females, the progeny of a single fly the third season would be capable of laying nearly seven million eggs. The killing of even a few flies would materially lessen the number and hold the pest in check.

2. The fact that the larvæ do not leave the fruit before it is ripe and are still found in abundance in the windfalls, would indicate the most vulnerable points in the life history of the insect and suggest two methods of checking the pest, viz.: Taking

care that the larvæ in the gathered fruit be not allowed to transform, and destroying the windfalls. The apples gathered for home consumption and for market may contain many maggots, as our observations show the larvæ are still in the fruit when ripe. The chances that these larvæ find the conditions for development are much less than with those that go into the ground from the windfalls, but the pest may be spread through marketed fruit or be perpetuated from fruit stored or used at home.

a. Infested apples in market places are a fruitful source of the pest, and fruit dealers should be required to burn or bury all apple refuse and not throw it on the ground.

b. The maggots in stored apples soon leave them and go into the pupa state in the barrels or bins. If marketed the pupæ go with the fruit in the barrel and may spread the pest. In bins and barrels in the cellar the pupæ no doubt retain their vitality and the flies emerge in the spring. As a precaution the bins should be carefully swept and the barrels shaken into a tight vessel and the refuse buried or burned. Apple refuse from home use should be destroyed and not thrown on the ground.

c. The maggots are not able to crawl out of a box and the refuse from market places, &c., could be thrown into a tight box or barrel and the maggots prevented from going into the ground. The refuse could occasionally be buried a foot or so deep.

3. Thorough and universal destruction of the windfalls is the most hopeful means of checking the pest. To carefully gather the fallen fruit every day from the early and later varieties from Aug. 1st until Nov. 1st and burn or feed it, would destroy many of the maggots. Sheep or hogs might be allowed the range of the orchard to eat the windfalls. *To leave the windfalls on the ground would favor the most rapid multiplication of the pest.* It is some trouble to gather the windfalls but it would be little compared with the benefits derived, if the pest can be checked. This fly annually destroys much fruit in some parts of the State and its ravages are increasing, and it threatens, unless checked, to be the most serious pest to apple growers. Its ravages are somewhat circumscribed but it will spread unless checked. Such a serious enemy needs concerted and determined action. The importance of rigidly adhering to this method for at least two years cannot be to strongly urged upon fruit growers whose orchards are infested.

4. If the above methods do not succeed there is a radical one that cannot fail. The destruction of the entire apple crop for one

season in the infested districts of the State by giving the flies no place to rear their maggots would about destroy the pest. We do not think this will be necessary if the careful destruction of windfalls and infested fruit is practiced. Should such a radical means be necessary the flies could be allowed to deposit their eggs and the fruit approach maturity when it could be gathered and fed and not prove a serious loss.

SUMMARY.

1. Thoroughly and promptly destroy all refuse from infested fruit, apple pomace, waste about the house, etc.

2. Promptly destroy windfall apples and infested fruit.

3. Destruction should be immediate after the first of August, and nothing short of deep burying, burning or feeding to swine or cattle will be effective.

4. These precautions should be universally adopted.

5. The sale or importation of infested fruit should be prohibited.

THE POTATO ROT.

PHYTOPHTHORA INFESTANS, DEBARY.
(*Peronospora infestans, Mont.*)

PROF. F. L. HARVEY.

We are daily receiving specimens of potato tops and leaves badly infested with the above disease, and believe the information given below will be of general interest.

LIFE HISTORY.

This fungus lives over winter in the form of resting or winter spores (oosporæ) which are found in the stems, leaves and tubers. The stems and leaves decay leaving the resting spores which retain their vitality in the ground, and from these, or from spores in the tubers, the disease starts the following spring. The fungus is deep seated in the stem and leaves of the potato, and later affects the new tubers. During the summer and fall it appears on the surface as a white mildew, which upon examination will be found composed of branching pedicils (conidiophores), bearing numerous minute white oblong bodies, the summer spores (conidia) of the fungus. These summer spores are carried by the

wind to other parts of the field, light on the plants, germinate, enter and augment the disease. During the summer, new winter spores are formed within the stems, leaves and tubers, completing the life history.

REMEDIES.

The methods of treatment are direct and preventive, from the fact that the parasite is internal and only appears at the surface while producing summer spores. The methods must be largely preventive.

DIRECT METHODS.

Any means by which the growth of the *summer spores* can be checked, would prevent the spread of the disease from plant to plant during the season, and prove beneficial.

The following solutions have been tried in France and in New Jersey with apparently satisfactory results and we would recommend them for trial in Maine:

SOLUTIONS.

No. 1.—Mix 1 qt. of strong ammonia water (hartshorn) with 3 ozs. of carbonate of copper. Stir rapidly until a clear liquid is produced. When ready to use it, dilute to 22 galons with water. Apply with a spraying apparatus or force pump.

No. 2.—Dissolve 1 lb. sulphate of copper (blue stone) in 2 gallons of hot water. When dissolved and cool add 1 1-2 pints of commercial ammonia water. Dilute to 22 gallons with water. Apply as stated above.

No. 3.—Dissolve 6 lbs. copper sulphate in 16 gallons water. Shake 4 lbs. of fresh lime into 6 gallons of water. When cool mix the above solutions slowly and thoroughly and apply as stated above.

NOTE.

Any spraying apparatus will answer. Select the recipe for which the material can be readily obtained. Spray as soon as the disease begins to show as a whitish mildew, or the leaves begin to blacken. We would be pleased to have a report from those who try these mixtures.

PREVENTIVE METHODS.

1. Burn the tops and leaves in the fall after the crop is gathered, to destroy the winter spores contained in them.

2. Gather all the small potatoes, for if allowed to decay in the field the winter spores in them will start the disease the

Report of Botanist and Entomologist.*

Prof. F. L. Harvey.

The following subjects have claimed attention during the past season:

BOTANY.

1. Germination experiments on the vitality of seeds, continued.
2. *Datura Stramonium*, L. Jamestown Weed. Described.
3. *Raphanus raphanistrum*, L. White Radish, or Jointed Charlock.
4. *Rumex crispus*, L. Yellow Dock.
5. *Rumex obtusifolius*, L. Bitter Dock.
6. *Bromus secalinus*, L. Chess or Cheat, considered and illustrated.
7. Several species of Mosses studied in reference to their value as foods for domestic animals.
8. Continuation of an examination of Potato Rot.
9. Continuation of an examination of Black Knot.
10. Correspondence regarding weeds, seeds and plants.
11. Examination of Seeds for impurities.
12. Collecting of seeds, weeds, forage and other plants for the herbarium, continued.

ENTOMOLOGY.

13. *Ixodes ricinus*, L. Tick.
14. *Smerinthus geminatus*, Say. Sphinx moth.
15. *Treptogon modesta*, Harris. Sphinx moth.
16. *Sphinx gordius*, Cramer. Sphinx moth.
17. *Agrostis saucia*, Hubner. Climbing cut-worm.
18. *Agrostis Ypsilon*, (Rott.) Greasy cut-worm.
19. *Hadena devastatrix*, (Brace.) Glassy cut-worm.
20. *Apatela lepusculini*, Gue. The Cotton Dagger.
21. *Aphonus tridentata*, Say. Three-toothed Aphonus.
22. *Dytiscus verticalis*, Say.
23. Three species of Rove Beetles.
24. *Elaphidion parallelum*, Newm.
25. *Ptinus brunneus*, Duft.
26. *Aphis mali*, Fabr. Apple Aphis.
27. *Cotalpa lanigera*, (Linn.) Gold-smith Beetle.
28. *Tetranychus 4-maculata*, n. sp. Four spotted mite.

* Taken in the Maine agricultural Experiment Station Entomologist's report.

Plants Received for Examination—1891.

WEEDS.

No.	Common Name.	Scientific Name.	From whom Received.	Remarks.
1	Jamestown weed.	Datura Stramonium, L.	Several parties.	Weed in gardens.
2	White Radish, or Jointed Charlock.	Raphanus raphanistrum, L.	A. J. Abbott, West Paris, Me.	Pods abundant in Western oats shipped to Maine.
3	Yellow Dock.	Rumex crispus, L.	Various parties.	Weed in waste ground, fields and gardens.
4	Bitter Dock.	Rumex obtusifolius, L.	Various parties.	Weed in waste ground, fields and gardens.
5	Chess, or Cheat.	Bromus secalinus, L.	Mr. F. V. Barker, Athens, Me.	Weed on the farm.

MOSSES.

6	Bog Moss.	Sphagnum cymbifolium, Ehrb.	Henry A. Sprague, Charlotte, Maine.	Sent for determination and for an examination as to nutritive value for feeding domestic animals.
7	Bear's Bed, or Robin's Rye.	Polytrichum Juniperinum, Hedw.		
8	Splendid Hypnum.	Hypnum Splendens, Hedw. H. proliferum, L.		
9	Schreber's Hypnum.	Hypnum Schreberi, Willd.		
10	Reindeer moss—a lichen.	Cladonia rangiferina.	Collected at Orono.	Analyzed for comparison.

List of Insects Reported and Examined—1891.

No.	Common Name.	Scientific Name.	By whom Reported.	Remarks.
1	Tick.	Ixodes ricinus, L.	Thos. Lord, Skowhegan, Me.	Infesting domestic cat.
2	Sphinx Moth.	Smerinthus geminatus, Say.	W. N. Bond, Orono, Me.	About apple trees.
3	Sphinx Moth.	Triptogon modesta, Harris.	Q. E. Young, Costigan, Me.	Habit not reported. Food plants, poplar and cottonwood.
4	Sphinx Moth.	Sphinx gordius, Cramer.	L. E. Fogg, S. Thomaston, Me.	Said to be feeding on the foliage of plum trees. Not abundant.
5	Climbing Cut-worm.	Agrostis saucia, (Hubner).	W. K. Burgess, Monroe, Me.	The eggs of this in abundance were found attached to resined cloth used for grafting.
6	Greasy Cut-worm.	Agrostis Ypsilon, (Rott.)	N. H. Sleeper, Lewiston, Me.	Working in corn, potatoes and beans.
7	Glassy Cut-worm.	Hadena devastatrix, (Brace.)	John M. S. Hunter, Farmington, Me. N. H. Sleeper, Lewiston.	Doing great damage in lawn of public building, and to corn.
8	The Cottonwood Dagger.	Apatela lepuscula, Gue.	W. H. Phinney, Standish, Me.	Upon plantain in door yard.
9	Three-toothed Aphonus.	Aphonus tridentatus, Say.	N. H. Sleeper, Lewiston, Me. C. V. Manley, Auburn, Me.	Accused of cutting off corn below ground.
10		Dytiscus verticalis, Say.	F. H. Skinner, Corinth, Me.	Found in cellar among potatoes.
11	Rove Beetles.	Three species.	W. K. Burgess, Monroe, Me.	Abundant fastened to resined cloth used for grafting.
12	The Parallel Elaphidion.	Elaphidion parallelum, Newm.	W. K. Burgess, Monroe, Me.	Boring in plum twigs.
13		Pinus brunneus, Duft.	Mrs. E. Gardner, Calais, Me.	Live larva and beetles in red pepper.
14	Gold-smith Beetle.	Cotalpa lanigera, Linn.	Alien Reed, Frye, Me.	Habitat not stated.
15	Apple Aphis.	Aphis mali, Fabr.	Ch. H. Pope, Manchester, Me.	Feeding on raspberry bushes.

Remarks.

Those of the above named plants and insects that have been sufficiently studied, or are of enough importance receive consideration below. The plates and cuts to illustrate this Report were obtained from the following sources: From the Dept. of Agric., Washington, D. C., the plate of *Bromus secalinus;* cuts 1, 2, 3, 4, 6, 7 and 10 from J. B. Lippincott & Co., and are after cuts in Saunder's Insects Injurious to Fruits; cuts 5, 8, 11, 12 and 13 were kindly loaned by Prof. S. A. Fobes and are after cuts in the Ill. Repts.; cut 9 is from a drawing made by the writer.

During the past season the writer assumed alone the botanical and entomological work of the Station, but Mr. F. P. Briggs, Assistant in the Natural History Department of the College, has continued in an efficient manner the germination experiments and collecting for the herbarium.

The appointment of a Station Horticulturist has transferred the work of the Botanist and Entomologist largely to the study of life histories of plants and insects found doing injury in the State. The Horticulturist has assumed the work of testing fungicides and insecticides. Insects and plants for identification and questions regarding their habits will be considered by the writer, but questions regarding spraying and spraying apparatus should more properly be referred to Prof. Munson. We take this occasion to say that any one desiring information regarding insects or plants is at liberty to send specimens or ask questions. We are glad to notice an increasing demand for such information. Directions for sending specimens will be found in Experiment Station Report, 1888, p. 194.

The past season has not been characterized by the wide spread occurrence of any one species of fungus or injurious insect. The ravages of the Forest-tent Caterpillar, so serious and threatening in 1890, amounted to almost nothing the past season, as we predicted would be the case in our last Report. The past season was quite wet and many complaints were received of injuries done by various species of cut worms. The Codling Moths and Apple Maggot were as abundant as usual in some sections of the State. There seems to be an awakening to the importance of spraying for Apple Scab and the Codling Moth, as more inquiries have been received than usual regarding fungicides, insecticides and apparatus. Complaints from two sources were received of injuries done to corn by *Aphonus tridentatus*, Say. This insect has never

before been accused of cutting corn in the hill after the manner of a cut worm. Our attention has been directed the past season to a species of mite which is common on house plants in Orono, and also in the forcing house at the College. This is the same species that has done so much damage at Cornell University and elsewhere in green houses. It seems to be wide spread and a serious pest. It is very closely related to the red spider, being a species of *Tetranychus*. There were some newspaper reports of the appearance of the Gypsey Moth in the western part of the State, but we are not able to find any authentic evidence that it is found in the State. The Fall Canker-worm has been gradually increasing in the Penobscot valley for the past four years. Last season it did considerable damage to the foliage of fruit and shade trees in this vicinity, and numerous eggs were laid last fall. It may be expected to give some trouble the coming season. Spraying with Paris green while the worms are young, is the remedy. The Apple Scab seems to be the most injurious fungus the orchardists have to contend with, but the use of copper compounds will no doubt prove an efficient remedy.

It may be well to state that the new Tachinid referred to in the Expt. Station Report, 1890, p. 139, as parasitic upon the Forest-tent Caterpillar and named *Phorocera promiscua*, Townsend, has since been referred by the same author to the genus *Meigenia*, and should now be called *Meigenia promiscua*, Townsend. See Psyche, Nov., 1891, p. 177.

BOTANY.

Jamestown Weed—Thorn Apple.

Datura Stramonium, L.

Specimens of the above species have been handed to us for determination several times during the past five years. We have observed the plant several times as a weed in gardens about Orono, and it may be common throughout the State. Whether introduced in garden or grass seed we do not know. Though it appears from year to year in this region, yet being a tropical plant it would probably not spread. It is a native of *Asia* introduced in America. In the South it grows several feet high and is a rank weed found about barns and out houses where the soil is rich, or in fields and along road sides. The seeds are officinal and constitute the *Stramonium* of the druggist. In the South the seeds are

pulverized and mixed with lard to form an ointment much used for healing sores. The plant may be known by the long, funnel-shaped, white corolla, with a large five to ten toothed plaited border; the large, globular, prickly seed pod, four celled at the bottom; the large, flat seeds, and the ovate, ill-scented foliage. The flowers are borne on short peduncles in the forks of the branching stems. The plant is a member of the order *Solonaceæ* to which the potato, tomato and tobacco belong. It is closely related to *Datura* (Brugmansia) *arborea*, a shrubby plant bearing white *Datura*-like blossoms fully six inches long and grown as a house plant in Maine and called *Wedding Bell*. Those who have access to the U. S. Agr'l Rept. for 1889, will find this plant figured on Pl. VII in the Report of the Botanist.

White Radish or Jointed Charlock.

Raphanus raphanistrum, L.

The following letter from Mr. Abbott, together with the response, being of general interest, are recorded.

West Paris, Me., Jan. 2, 1890.

W. H. Jordan.

Dear Sir:—I send you some oats with which are some seeds that are new to me. Can you tell me what they are? They are Western oats such as are brought here by the car load for feed.

Very Respectfully,

A. J. ABBOTT.

Response.

Orono, Me., Jan. 9, '91.

Mr. A. J. Abbott,

West Paris, Me.

Dear Sir:—Your letter and package were handed me by Prof. Jordan for consideration. The foreign matter in the oats sent consists of the pods and included seeds of *Raphanus Raphanistrum*, *L.* The Wild Radish or Jointed Charlock. The plant yielding these pods is a troublesome weed in Eastern New England and farther west. It is a near relative of the garden Radish, *Raphinus sativus*, *L*, and was introduced from Europe. This plant belongs to the Order *Cruciferæ* or *Mustard Family*. The pods are necklace-formed and break into joints by constrictions

between the seeds, as shown by the specimens sent. By examining the joints of the pods, you will find the *brownish spherical* seeds. What the physiological effects of eating so much radish seed would be upon animals I cannot say, but as the seeds of some *cruciferous plants* yield an irritating pungent oil, the effect would probably be like that of mustard seed, laxative and stimulating to the digestive organs. This effect would not be desirable in healthy animals. The radish seed, though an adulteration, would have some nutritive value. Clean oats would be preferable and this adulteration ought to make them of less market value. Such oats should not be used as seed, as this bad weed would be introduced wherever they were sown. It would not be possible to feed such oats on the farm without introducing the weed. We would advise farmers not to buy them. The weed is already in the State, being rather common about Orono. Care should be taken not to further extend it. It may be said in its favor, that it is an annual; and could be eradicated in one season, by careful tillage. We would like to know whether the oats received from the West are often thus adulterated or whether this is the first time you have seen it. I wish you would send me a quart of the seed adulterated just as taken from the car. I want to determine the per cent. of foreign matter and keep the sample for the museum.

Yours very truly,

F. L. Harvey,

Botanist for the Station.

Yellow Dock and Bitter Dock.

Rumex crispus, L, *and Rumex obtusifolius*, L.

The above species sent for determination are common weeds in fields, gardens and waste ground. They are naturalized from Europe. The Curled Dock is smooth, has lanceolate acute leaves with the margins strongly wavy curled. The lowest leaves truncate or scarcely heart-shaped at the base. The flowers in crowded whorls on a long wand-like raceme. The valves (three inner sepals) round, heart shaped with an obscure toothed or entire border and nearly all grain bearing.

The Bitter Dock has a rough stem, the lowest leaves ovate heart-shaped and obtuse. Flowers in loose, distinct whorls. The valves strongly veined, ovate shield-shaped with sharp, awl-shaped teeth at the base. Only one usually grain bearing.

These plants belong to the order *Polygonaceæ* or Buckwheat Family, and are related to the smart weeds and the cultivated buckwheat. They are figured in the U. S. Agr'l Rept., 1889, Pl. VIII and IX in the Rept. of the Botanist.

Those interested in the species of *Rumex* (docks) occurring in the United States, will find all the species considered (about twenty) and finely illustrated in the Third Annual Report of the Mo. Bot. Garden, in an article from the pen of Prof. Wm. Trelease, Director, St. Louis, Mo.

MARX. DEL.

CHESS, OR CHEAT

(*Bromus secalinus*.)

Chess, or Cheat.

Bromus secalinus, L.

A letter containing specimens of the above named grass was received from Mr. F. V. Barker, Athens, Me., who stated that the plant grew on his farm and he wished to know whether it was of any value. The following response may be interesting in connection with the cut we give of this species on the opposite page.

Orono, Me., Dec. 10, '91.

Mr. F. V. Barker,

Athens, Me.

Dear Sir:—The specimen of grass you forwarded to Prof. Balentine has been handed to me for examination. It is Chess or Cheat, known to botanists by the name *Bromus secalinus*, L. Some farmers still hold to the old tradition that Chess is a degenerate wheat, but most now know it is a distinct species, which sometimes overruns grain fields. The seed is sometimes sown with the grain, but more often gets in from neglected fence corners or hedge rows. It is a very hardy, coarse plant, that seeds profusely and would soon overrun a field if not checked. It is an annual, hence careful cutting for one season would eradicate it. It is of no value to the farmers of Maine, though it has been suggested as a winter grass for the South, where some of its near relatives are esteemed. It is rather to be regarded as a weed and should be destroyed. It is not a native grass, but was introduced from Europe. It may be recognized by the aid of the accompanying cut and the following description: Flowering glume oblong, convex on the back; flowers lapping over one another before expanding; lower empty glume distinctly 3—5 nerved, the upper 5—9 nerved, annual; panicle spreading, even in fruit, the drooping peduncles little branched; spikelets oblong-ovate, turgid, smooth, of 8—10 flowers; glume rather longer than the palet, short awned or awnless; sheaths nearly glabrous. Growing in fields or waste places as though introduced.

Respectfully,

F. L. Harvey,

Botanist for the Station.

Examination of Mosses.

L. H. Merrill and F. L. Harvey.

The following letter was received at the Experiment Station last fall.

Charlotte, Me., Nov. 30, 1891.

Messrs. of the Experiment Station.

Dear Sirs:—As the U. S. Agr'l. Repts. and Bentley's Botany, state that some mosses are rich in nutriment, and as our school text books skip these cryptogams, I send you three specimens for examination, which I hope you will report upon to me as soon as convenient.

No. 1 is found in large quantities covering mossy low bogs with a soft cushion from six to eighteen inches thick. If *scalded* and mixed with a very little *corn meal* it is eaten with apparent relish by swine.

No. 2 grows on a little higher ground around the edge of bogs.

No. 3 grows in sandy places on high ground. Have any of them any nutritive value as foods for animals?

Yours truly,

HENRY A. SPRAGUE.

The specimens refered to above were submitted to the Botanist of the station for botanical determination and to the Chemist of the station for analysis, with the following results.

Botanist's Report.

No. 1. Sphagnum cymbifolium, Ehrb. Bog Moss.

No. 2. Polytrichum Juniperinum, Willd. Bear's Bed, or Robin's Rye.

No. 3. Hypnum splendens, Hedw.—H. proliferum, L.

No. 4. Hypnum Schreberi, Willd.

No. 5. Cladonia rangiferina. Reindeer Moss—a *lichen*.

Remarks.

Mr. Sprague's No. 3 was a mixture of two species, Nos. 3 and 4 above, which are reported in the analysis. No. 5, the Reindeer Moss, being a well known food of species of *Cervidæ*, was submitted to chemical examination for the sake of comparison.

The accounts given in works on botany, or elsewhere of *mosses*

being used as food for man and the lower animals, generally if if not always refer to *lichens*, which should not be confounded with the *musci* or true mosses. We find no authentic record of *true mosses* being eaten voluntarily or having been fed to domestic animals. It is a fact of common observation that the domestic animals reject them. This may be due to their being unpalatable or possibly in some cases to deleterious properties. As animals will not eat them unprepared, they would have to be mixed, if fed, with something to make them palatable, as was done by Mr. Sprague. Whether they possess deleterious properties would have have to be determined by feeding experiments for each species. As the mosses have apparently never been examined chemically to determine their nutritive value, the results of the Station Chemist given below will be interesting. They indicate that the species examined contain much more nitrogen than the *lichen* (reindeer moss,) which is freely eaten by species of deer and that they compare favorably with timothy hay in amount of nitrogen, though it is less easily digested. A series of experiments to determine palatability, deleterious properties and digestibility would be interesting. A more exhaustive analysis might detect compounds that would materially affect the food value. The following is the

REPORT OF THE CHEMIST—MR. L. H. MERRILL.

Since the mosses are not likely to become very important food plants, it was not thought advisable to make a complete analysis of the specimens submitted, but to confine the work to a brief examination of the nitrogenous compounds which they contain. While we do not know the exact nature of these compounds as they exist in the species examined, yet it may be assumed that their value may be determined with some degree of accuracy by applying the same methods used in the study of fodders.

It is evident that the value of the mosses as food must depend upon their digestibility. They were accordingly submitted for twenty-four hours to the action of pepsin solution, prepared in the ordinary manner. The nitrogen was determined in the undigested residues, and the per cent. of the whole amount of the nitrogen digested calculated from these figures.

As a matter of interest a common lichen (Cladonia rangiferina) was added to the list. Two well-known fodders, Timothy Hay and Alsike Clover, have also been inserted in the table for more ready comparison.

Station number.	Names.	Mixture.	Total nitrogen.	Not digested by pepsin, %	% of total not digested.
CLIII....	Sphagnum cymbifolium, Ehrb.....	8.30	.89	.60	33
CLIV. ...	Polytrichum juniperinum, Willd...	5.25	.90	.74	18
CLV.	Hypnum splendens, Hedw.....	10.09	1 24	.79	36
CLVI....	H. schreberi, W lld.....	9.80	.94	.73	22
CLVII...	Cladonia rangiferina.....	6.59	.42	.23	45
XLIV....	Timothy Hay	.....	1.20	.34	72
XLI.....	Alsike Clover.....	.....	2.03	.55	73

It will be seen from these figures that one of the mosses contains as much nitrogen as the Timothy Hay; the others about three-fourths as much. The digestibility, however, in all of them is very low, in none of them reaching more than one-half that shown by Timothy. Nevertheless, if these figures be accepted as representing the actual food-value of the mosses and they prove palatable—which is doubtful—the facts obtained would seem to justify farther study.

Examination of Seed for Impurities.

The Station is prepared, so far as its facilities permit, to examine seeds for the presence of noxious weeds, and report upon them. Below is given the results of an examination to call attention to the nature of the work. Seeds of weeds present that can not be identified at sight, are grown and positively determined from the plant. Those intending to plant large areas of clover or grass could be assured of the absence or presence of noxious weeds and sometimes avoid the introduction of pests hard to eradicate when once established.

Report.

Weight of seed examined, one half ounce.
Name of seed, Red Clover, Trifolium pratense, L.

Total number of weed seeds,	121
Harmless—Herds Grass, Phleum pratense,	30
Harmful—Fox tail, Setaria glauca,	59
" Smart weed, Polygonum acre,	12
" Black Bindweed, Polygonum convolvulus, L,	
" Polygonum ?	
Rib Grass, Plantago lanceolata, L.	5
Unknown Weeds, two kinds,	15
Total,	121

Received from Mr. G. S. Flood, Waterville, Me., and purchased from F. J. Savage, Ft. Fairfield, Me.

Remarks.

It is impossible to get seed entirely free from foreign seeds. It is important, however, whether the few found are *harmless* like herds grass seed in clover, or whether they are the seeds of bad weeds. The above seed can not be regarded dirty, as the weight of foreign matter is very small, but it contains the seed of the *foxtail* and *English plantain*, one would not care to introduce in a meadow. For my own planting I would reject such a seed as the above.

ENTOMOLOGY.

Ticks.

Ixodes ricinus, L.

(Ord. Acarini: Fam. Ixodidæ).

We received specimens of a species of Tick from Mr. Thos. Lord of Skowhegan, found on the domestic cat. The American species of Ticks have not been studied much and the writings on the subject are meagre. Not being able to find a description of the species, some of the specimens were referred to the Dept. of Agric., Division of Entomology. They were examined by Dr. Marx, and Prof. Riley writes us that the form is *Ixodes ricinus*, L. The species sent us is very common in Maine and is the one which so badly infests our wild hare, or rabbit. We have seen rabbits during the month of July with the head almost covered with these ticks and in such a condition it must have been a misery to live.

Dr. Marx of the Dept. of Agric., we understand, is studying this group, and we may hope for a monograph of our American species.

Sphinx or Hawk Moths.

(Order Lepidoptera: Fam. Sphingidæ.

During the past season three species of sphinges have been received for examination, viz: *Smerinthus geminatus*, Say., *Triptogon modesta*, Harris, and *Sphinx gordius*, Cram.

As these moths are apt to attract attention on account of their size, a few words regarding them may be interesting.

They are called Sphinx moths, or Sphinges, because the *larvæ* have the curious habit of raising the anterior portion of the body and remaining motionless for a long time in that position, thus bearing a fancied resemblance to the fabled *Sphinx*.

HABITS.

The eggs are laid singly on the food plant, hatch in one or two weeks; the young larvæ are usually pale green or yellowish green and clothed with short, erect hairs. They molt or shed the skin about four times before they are fully grown. They have on the twelfth segment a spine that curves backward and is called the *caudal horn*. (This horn disappears after the first molt in a few species.) The mature larva is cylindrical and smooth or granulate. When done feeding they descend and usually enter the ground to transform, though a few make imperfect cocoons on the surface made of leaves drawn together with silk.

The moths are medium sized to large, the bodies short, fore wings comparatively long and narrow, hind wings much smaller, head large, clothed with hair-like scales, either tufted or appressed; eyes, large, hemispherical, naked. The proboscis usually long and slender and when not in use, coiled like a watch spring between the palpi. The wings usually move rapidly in flight. They are sometimes taken for humming birds. This is quite a large family, there being, according to Prof. J. B. Smith, over eighty species in temperate North America. According to Prof. Fernald there are nearly fifty species in New England, the most of which occur in Maine. Quite a number of the species feed upon the foliage of fruit trees, forest trees and shrubbery of economic importance. Of those mentioned above, *Smerinthus geminatus*, Say., is a general feeder and has been found upon the apple, plum, elm, ash and willow.

Triptogon modesta, Harris, feeds upon the poplar and cotton wood.

Sphinx gordius, Cramer, (Fernald Sphinges of New England, p. 11, Fig. 1, Pl. 1), has been called the Apple Sphinx on account of its common occurrence in orchards, but it feeds upon the ash, also upon the Sweet Gale (Myrica Gale, L. and the Wax Myrtle, Myrica Cerifera, L.) Those who are interested in the above species, or in the Sphinges generally will find the Sphinges of New England considered in detail in Fernald's Sphingidæ of New England, published in the Agr'l Rep't of Maine, 1886, or the Sphinges of America, north of Mexico, in Prof. J. B. Smith's Monograph, published by the American Entomological Society of Philadelphia, Pa.

Cut-Worms.

The following letter regarding cut-worms was received at the Station. We place it and the answer on record as containing information perhaps important to others.

Farmington, Me., 6, 5, 1891.

Dear Sir:

I send you by this mail specimens of a worm which is destroying a lawn in this place, in front of and around our county building. The soil is sandy and it has been top dressed for several seasons to get the lawn; and now the turf is about two inches thick. Rear of the building is a cemetery, been there for over a century.

Will you kindly look into this matter; tell us what the worm is, how to prevent further ravages by it, and what to do to kill out the thousands of worms now eating away at the grass roots.

I shall make an item about this lawn, also say I have sent specimens to the State College; and I hope you will write an article upon them to print in my paper. Nobody here, thus far has ever seen these worms here before.

Yours very truly,

John M. S. Hunter.

Answer to Mr. Hunter's Letter.

Orono, Me., July 24, '91.

Editor of Farmington Chronicle:

The specimens which you sent me some time ago for examination prove to be the Glassy Cut-worm known to entomologists as *Hadena devastatrix*, (Brace). There are a great many species of the so-called *Cut-worms*; some of them climb trees and eat the foliage, while others work about the roots or base of plants. They all do more or less damage and work at night. As a class they are hard to manage. When they are not numerous and affect gardens, digging them out of the hills where their depredations are noticed, or putting bunches of hay or small boards on the ground for them to hide under, and then examining and killing them, have proved good remedies.

When they affect field crops, meadows or lawns the treatment would have to be different and on a more extensive scale. If the lawn has been so far affected that the grass is dead and re-seeding will be necessary, the ground should be plowed next Spring and before the seed is sown a load of fresh cut grass

thoroughly sprinkled with Paris green in water, 1 lb. to 150 gallons of water, should be spread upon the ground and left a few days. The worms will crowd to the surface for food, eat of the poisoned grass and die.

This same treatment has been successfully tried for cut-worms in corn fields or other crops planted in rows, the poisoned grass or clover being scattered in small bunches between the rows. If the lawn has not been destroyed so that re-seeding is necessary, and it is desired to treat it without disturbing the sod, then we would advise the use of Kerosene Emulsion. This has been successfully used for grubs in lawns at the Department of Agriculture, Washington, D. C.

You will find an account of the Experiments in Insect Life, Vol. 1, No. 2, page 48. (This journal is published by the Department of Agriculture and you can no doubt get a copy by addressing the Secretary of Agriculture.) You will find a formula for the preparation of Kerosene Emulsion in Dep't of Agriculture Report, 1884, page 331, and also some other information on the subject that will be instructive. Other articles on the treatment of cut-worms will be found in Insect Life, Vol. 3, No. 5, page 247; U. S. Agricultural Report 1885, page 270; Prof. Fletcher's Report, Central Expt. Farms, Ottawa, Canada, 1889; Canadian Entomologist 1889, Sept. or Oct., also in the writings of Prof. Cook and other entomologists to the Experiment Stations.

As the above cut-worm goes into the chrysalid state in July, its depredations are probably over for this season and it is more than probable, it apparently being confined to the lawn in question, that it will not give so much trouble next season. The chrysalids hatch into moths in the latter part of August or September and they will scatter to lay their eggs. Cut-worms are apt to be badly preyed upon by parasites and thus destroyed. Should they begin work again next Spring I would advise the grass trap or Kerosene Emulsion treatment. Should you need any more detailed information than I have given, write again.

Yours truly,

F. L. Harvey,

Entomologist for the Station.

Remarks.

The above species, *Hadena devastatrix* (Brace), together with the Greasy Cut-worm, *Agrostis Ypsilon* (Rott.), were received from Mr. Sleeper, Auburn, Me., see letter pp. 200, 201, also reared by the writer from worms doing damage to corn and other crops about Orono. A species of Climbing Cut worm, the Variegated Cut-worm, *Agrostis saucia* (Hubner), was sent by Mr. W. K. Burgess, Monroe, Me.

The above species are considered and figured below. The term *Cut-worm* is very loosely used, being often applied to the larva of the *June bug*, which cuts grass roots; to the *wire worms*, the larvæ of the snapping beetles, and even to the *borers* that cut channels in woody plants. The term cut-worm is principally confined by entomologists to larvæ of the Owlet Moths (*Noctuida*), that have the habit of hiding just under the surface of the ground during the day and feeding upon the roots, stem or leaves of plants by night. When the larvæ climb high and feed upon the foliage of tall plants or trees, they are called *Climbing Cut-worms*.

The cut-worms may be known by the following general characters:

The moths known as *Dart Moths* or *Owlet Moths* are deltoid or triangular in shape (see Figs. 4, 6 and 7) when the wings are closed, and usually fly at night, and often enter rooms, being attracted by the light. The worms when full grown measure from one to two inches in length, have sixteen legs (three pairs of true legs and five pairs of prolegs), thick bodies which taper somewhat at the ends; without hairs and greasy looking, brown gray or greenish with indistinct longitudinal or oblique markings; head long, shining red or brown, head and anal segments armed above with a horny plate, darker than the remainder of the body. On each segment are six or eight dark colored humps, each bearing a hair. (See Fig. 6.) When disturbed the worms curl themselves into a ring as shown in Fig. 2. There are between three and four hundred American species related to the cut-worms and many species besides the above are numbered among the pests of the farm, garden and orchard.

The Variegated Cut-worm.

Agrostis saucia (Hubner).

(Ord. Lepidoptera: Fam. Noctuidæ.)

DESCRIPTION.

Eggs—round, flattened, pink, prettily ribbed and ornamented, laid in patches of several hundred on the twigs of the apple, cherry and peach. Mr. Monroe's specimens were found on the *trunks* of *plum* trees. Fig. 1, *a*, represents an egg enlarged, showing the ribbing and ornamentation. Fig. 1, *b*, represents a cluster of the eggs, natural size, attached to a twig.

Fig. 1.

Larvæ, when young, dull yellow marked with darker spots. Full grown larva, dull flesh color, mottled with brown and black and elongated velvety black markings on the sides, large, when mature nearly two inches long. Fig. 2 shows the larva at rest and the head magnified to show the markings. The larvæ are mature in June, when they enter the ground form an oval cavity within which they

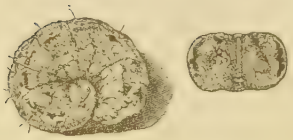


Fig. 2,

Fig. 3.

change to the *chrysalis*, which is deep mahogany brown, pointed at the extremity, as shown in Fig. 3.

Fig. 4.

The *moth*, shown in Fig. 4, expands about one and three-quarters inches and the fore wings are grayish brown marked with brownish black; the hind wings are white and pearly, shaded toward the margin with pale brown. The moth is on the wing in July and lays its eggs as shown above.

The Glassy Cut-worm.

Hadena devastatrix (Brace).

(Ord. Lepidoptera: Fam. Noctuidæ.

The eggs of this species and the egg-laying habit, so far as we know, are not known. Probably the eggs are laid on plants near the ground, which is the usual place of depositing them by cut-worms, and not in the ground, as formerly supposed. Brace, who originally described the moth, says the eggs are laid in autumn and hatch in May. The belief among entomologists now is that most cut-worms hatch in the fall and enter the ground, maturing the following spring.

Larva—length 1.8 inches, color translucent glassy green with a tinge of blue; head venetian-red, jaws black, a small black spot on each side, head shield distinct, hard, polished, dark brown; caudal plate not so well defined and pale. The larvæ is full grown the last of June and soon changes to the *chrysalis*, which is dark mahogany brown, attenuated at the end more than usual, two distinct slightly curved horns at the end with several stiff bristles around them. The larvæ is shown, Fig. 5, natural size; below the larva is one of the segments enlarged, showing the dots bearing hairs, usually found on cut-worms.

Fig. 5.

Fig. 6.

Moth—spread of wings from an inch and a half to an inch and three-fourths; fore wings grayish brown crossed with four more or less distinct white wavy lines, edged more or less with black; hind wings pale brownish gray. This species is on the wing in July. Those we transformed came out the third week in July. It is shown natural size in Fig. 6.

Feeding upon grass roots and corn in the hill, in Maine. Stalks of corn eight inches high were found cut by this species. Brace says it prefers beans, and several writers accuse it of cutting cabbage. It does not seem to be so abundant in Maine as the next species, though locally about Farmington, Auburn and Lewiston it did considerable damage the past season. This species is found in Canada and in the Southern and Middle States and we believe it has been found in Europe.

Greasy or Black Cut-worm.

Agrostis Ypsilon (Rott.)

(Ord. Lepidoptera: Fam. Noctuidæ.)

Eggs—pale fulvous; nearly spherical, base somewhat flattened; laid in small patches, often of two or three layers and sparsely covered with long scales from the abdomen of the female moth.

Larvæ when full grown about an inch and a half long, dull lead brown color with five longitudinal paler stripes; under side of body pale greenish yellow.

The *Moth*, Fig. 7, has dark fore wings with a bluish tinge on the front border and with a dark brown lance-shaped mark running from the posterior portion of a kidney-shaped spot in the middle of the wing. Hind wings pearly white and semi-transparent.

Fig. 7.

This species is world-wide in its occurrence and does great damage to garden and field crops. It has been found destroying cabbage, tomatoes, potatoes, tobacco, cotton, corn and beans. In confinement it will feed upon apple and grape leaves. There are two broods and the moths are on the wing from April to October. Those we reared emerged the last of August. It was found by Mr. Sleeper cutting corn, but more abundantly by him in potatoes. We bred the moths from worms taken in corn hills, but did not notice their work in potatoes near by.

Remedies.

The remedies may be divided into *natural* and *artificial*. Natural remedies are those provided by nature to hold insects in check and prevent their undue increase. Under this head would come *parasites*, like Ichneumons and Tachina flies, that lay their eggs in the worms and destroy them; *predaceous insects*, as various species of beetles, hemiptera, mites and spiders; *birds*, as the robin, catbird, blackbirds and poultry; and *quadrupeds*, as the skunk and probably moles, all of which eat them.

Artificial remedies are those devised by man to protect his crops, or destroy the insects feeding upon them. They may be divided into *preventive* and *destructive*.

Preventive are those that protect the plants from attack, but do

not destroy the insects. *Destructive* are those that attempt to effectually remove the cause of the injury by aiming at the life of the insect.

PREVENTIVE REMEDIES.

a. *Application of chemicals or other substances to the soil*, which do not poison the worms but makes their food unpalatable. They do not seem to relish *salt* like the higher animals, and its use is highly recommended by Lintner and others. A handful is applied on the surface to each hill. Soaking the seed in *Copperas water*, one pound to the bushel of seed, allowing it to remain twelve hours, and then rolling it in plaster, would come under this head. This method is strongly recommended by Lintner. Tobacco has been used successfully to protect cabbage plants. It is put under the surface around the plants.

b. *By protecting the plants so the worms cannot reach them.* Under this head would come wrapping cabbage and other set plants with brown paper, burdock, walnut, or other leaves, or surrounding the base of the plants with tin or paper tubes or frames. Paper frames should be made broader at the top to prevent the worms crawling up the sides and set a little below the surface of the soil at the bottom. Tin tubes are much more durable. They can be made of slips of tin 2 in. by 10, bent in the form of a cylinder, and bent so as to loop at each end. They should be painted inside to prevent burning the plants by the sun. Bands can be made of tin and put around the base of fruit trees to protect them from climbing cut-worms.

Fitch recommended digging a shallow trench with perpendicular sides around the garden. This is based upon the belief that cut-worms travel to the cultivated ground from the adjoining meadows and pastures to feed upon the tender, cultivated plants.

c. *By thick planting* so as to have a good stand left after the worms have been fully fed. As Fitch expresses it, "plant one seed for the blackbird, two for the crow, three for the cut-worm and three to grow."

d. *By dusting the foliage with dry powders* like hellebore, ashes, or air slacked lime, to make it unpalatable to the worms.

DESTRUCTIVE REMEDIES.

a. *Early plowing in the Fall.* This destroys the weeds upon which the young worms feed and they starve. After summer crops are harvested the weeds are usually allowed to grow, giving the worms abundant food.

b. Late Fall plowing. This should be done after the worms have become torpid and have gone into winter quarters, so as to break the walls of the cells in which they hybernate, thus exposing them more fully to the changes of temperature.

c. Early Spring plowing and late seeding is supposed to cut off their food supply and starve them.

d. Late Spring plowing and seeding is supposed to give the worms a chance to mature on weed food and transform before the crop is planted.

e. Frequent cultivation of sod land is supposed to be beneficial. The moths lay their eggs upon plants near the ground. They deposit more eggs upon grass ground than elsewhere and the worms would accumulate in meadows. Turning every two years is advocated by some. Summer fallowing has been advocated in extreme cases.

f. Making deep holes about the hills with a dibble has been tried with good effect. For this purpose a sharpened stick about two inches in diameter is used. It can be thrust very rapidly deep in the soil once or twice near each hill. This makes a smooth, round hole into which the the worms fall and cannot get out, and they perish or eat each other. To make their death certain go over the field again the next day, thrusting the stick in the same holes to crush them.

g. Pouring solutions about the hills poisonous to the worms. Saltpetre has been used for this purpose and is said to destroy the worms and at the same time provide nitrogen food to the plants.

h. Dipping plants to be set in Hellebore Solution has been successfully used with tobacco plants. We have no record of its being tried for cabbage plants. One pound of Hellebore to ten gallons of water was used for tobacco plants.

i. Digging out the worms when the plants are seen to be affected by them. This is somewhat like locking the barn after the horse is stolen, but you have the satisfaction of destroying the perpetrator. Preventive remedies leave the worms to multiply over two hundred fold. Such a remedy as the above strikes a hard blow at the cause. This is a laborious method, but in connection with thick planting so a good stand will be left, it is effectual and largely practised.

j. Spraying the foliage with London purple, Paris green or Hellebore water will kill species that attack the foliage.

k. Shaking the trees or vines early in the morning and destroying the worms that fall has been recommended for climbing cut-worms.

l. Kerosene Emulsion has been successfully tried at the Dept. of Agric., Washington, D. C., for destroying root-eating grubs in grass grounds and would, without doubt, prove as effectual in killing cut-worms under similar circumstances.

For grass grounds we quote from Mr. Cogan's report to Prof. Riley (Insect Life, Vol. 1, No. 2, p. 49), the following: "The places affected were thoroughly drenched with an emulsion of kerosene in the proportion of one to sixteen, and the ground then well watered. I found that where this emulsion was used the grubs immediately ceased their depredations, penetrated further into the ground and not a live one was found to date after careful search, while in other places, where the emulsion was not used, they are still working in a lively manner." For the details of the experiment see periodical quoted above. The above method could be used to destroy the grubs of the May beetle as well as cut-worms.

We copy the formula for preparing kerosene emulsion from U. S. Dept. of Agric. Rept., 1884, p. 331, where further details may be found.

Kerosene, - - - - - -	2 gallons,	67 per cent.	
Common soap or whale-oil soap, -	1-2 "	} 37 "	"
Water, - - - - - -	1 "		

Heat the solution of soap and add it boiling to the kerosene. Churn the mixture by means of a force pump and spraying nozzle for five or ten minutes. The emulsion, if perfect, forms a cream which thickens on cooling, and should adhere without oiliness to the surface of glass. Dilute the emulsion, before using, with nine parts of water. The quantities used above, when diluted, would make thirty gallons of wash. Prof. Riley urges the importance of proper emulsion, while Prof. Cook uses the following formula: Dissolve 1-4 lb. hard soap in two quarts boiling water, add 1 pint of kerosene and mix thoroughly. This should form a thick, cream-like mass. Before using, dilute with two gallons of water.

m. Killing the worms before the crop to be jeopardized is up, or the plants to be set are put out. There are several ways of accomplishing this end, known under the general names, ball trap system, and poison ball trap system. In all of these methods the

land should be plowed early and the natural food of the worms destroyed. While they are starving, green food, as grass, clover, cabbage leaves, etc., may be put in bunches through the field.

The worms collect to eat this food and crawl into the ground near by when done feeding or secrete themselves under the traps, and can readily be dug out or caught and killed. In the poison bait trap system the food is poisoned, thus saving the trouble of digging or searching for the worms.

Prof. Cook poisoned clover and then forked it from a wagon in small bundles, at intervals through the field. Prof. Riley recommends that the food will keep fresh longer if tied in balls or loose masses. Another party put poisoned cabbage and turnip leaves in rows fifteen to twenty feet apart through the field. The food can be poisoned with Paris green or London purple, preferably in suspension in water, though some have mixed it with plaster or flour.

The Cotton-wood Dagger.

Apetala lepusculina, (Gue.)

(Ord. Lepidoptera: Fam. Noctuidæ.)

The larva of the above species was received from Mr. W. F. Phinney, Standish, Me., and said to be feeding upon the leaves of the door-yard plantain. So far as we know, it has never before been reported as feeding upon species of *Plantago*. As the name indicates, it usually feeds upon the cottonwood, *Populus monilifera*.

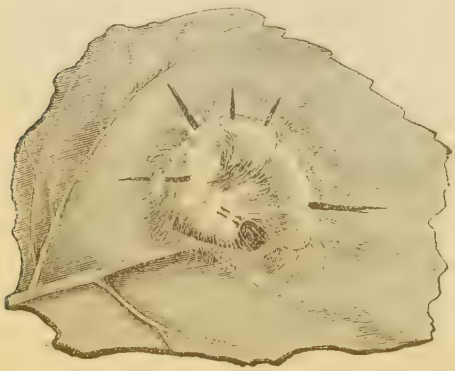


Fig. 8.

This species may be known by the following description:

Larvæ, when young, almost white with a distinct black dorsal line, short black tufts and sparsely covered with white hairs. When full grown, greenish yellow and thickly covered with long, soft, bright yellow hairs,

which grow immediately from the surface and curl round the sides each way from the middle of the back; head black. There are two little black spots on the top of both the first and second segments, with a pale line between them. The top of segments 1, 6, 7, 8, 11, each bear a straight black brush of hairs. When at rest the larvæ remains curled upon the leaf as shown in Fig. 8. Our specimen agreed exactly with the above description in the number of black brushes, though some specimens have only three tufts, others six, and occasionally there are a few black hairs among the yellow on the body. Our specimens were received about August 1st, which would indicate the second brood, the first brood emerging in June. When grown the larvæ seek a sheltered place, chink in the bark of a tree or cap of fence, and change to a dark, shiny brown chrysalis, encased in a pale yellow cocoon composed of silk and hairs of the caterpillar. The insect passes the winter in the cocoon.

The *moth* has light gray fore wings with a broken black band near the margin and a few black spots in the middle. Hind wings white with black marks in the fringe.

Three-toothed Aphonus.

Aphonus tridentatus, Say.

(Ord. Coleoptera: Fam. Scarabidæ.)

Scarabæus tridentatus, Say, Jour. Acad. Nat. Sciences, Vol. 1, No. 2, June, 1817. Original description Say's Entomology, Vol. 11, p. 134. Proc. Acad. Nat. Sciences, 1856, pp. 21-23.

The technical description of the beetle as given by Say. is as follows:

Body black, punctured, clypeus, scabrous; an obsolete elevated abbreviated line in the middle; an elevated transverse tridentate line on the anterior submargin, confluent each side, with the lateral reflected edge; tip much narrowed, emarginate, reflected; thorax, punctures generally diffused; scutel impunctured; elytra with punctured striæ, beneath reddish brown. Length three-fifths of an inch. Described from a single specimen brought from Arkansas by Thos. Nuttall.

Fig. 9.

Popular Description of the beetle. Body black, thick set and about three-fifths of an inch long, head and thorax marked with small round pits. The head apparently ending in an upturned border bearing three teeth (the teeth are borne on the clypeus). The wing cases (elytra) each marked with about nine longitudinal pitted furrows, those on the edge obscure; legs stout, under side of body and legs reddish brown. The beetle is shown in Fig. 9, about one-fourth too large. The head is shown turned down so that the suture between the clypeus and epicranium does not show, and the teeth and the clypeus projecting forward appear in relief.

This species is distributed from Maine to Texas, but nothing is known of its habits or transformations. It has not before, so far as we can learn, been accused of doing injury to crops. The writer received specimens of this beetle the past season from Mr. Nathaniel H. Sleeper, Lewiston, Me., and from Mr. C. V. Manley, Auburn, Me. It was accused by both parties of cutting corn in the hill after the manner of the cut-worm. In the mouth of two witnesses the guilt would seem to be established.

Below we give the evidence found in the letters accompanying the specimens.

Lewiston, Me., June 25, 1891.

To W. H. Jordan, M. S. C:

Dear Sir:—I herewith send to you some samples of a corn destroyer that I found while hoeing my corn. What I want to know is whether the bugs I send are enemies or friends; whether the bug eats the corn, or whether he is after something that does. I found some ten or twelve of these bugs just by the stalks of corn and sometimes one or two inches under the surface, and sometimes there were two or three stalks eaten in one hill. In three instances I found the black cut or corn worm; once the worm and bug in the same hill, and one time a worm in the midst of the stalk eating his way up.

If you can put me in the way of saving the corn you will oblige me very much.

Nathaniel H. Sleeper.

When we received the above letter we were of the opinion that the cut-worms were entirely responsible and we wrote Mr. Sleeper to this effect and requested him to examine farther, and following is the response.

2ND LETTER.

LEWISTON, Me., July 1st, 1891.

F. L. HARVEY:

Dear Sir:—I received your letter last evening and thank you very much for it. I went out early this morning and dug into some hills of corn. In the first one found a beetle. Dug into a few more and found none, but found 24 hills of corn that had been dug into during the night. In some of them the roots had been all laid bare, and some only dug into at the side by some animal, I think a *skunk*. I suppose he was digging for beetles.

This evening I went out to the corn to look for worms and beetles. I dug into twenty hills; in nine of them I found the same beetle, in five were worms, in six were nothing found; in two of the five were worms in the stalk above the ground about 3 inches. The smallest one I send to you.

The large, dark colored one is he that eats off the stalk above ground and eats potato stalks and the beans more than he does the corn. The other two large ones were found where the stalk was eaten an inch below the surface, one in a place. These two are larger than others, and had the same appearance of those I found some days ago.

The largest black worm is seldom found in my corn; he is plenty in the potatoes. The two large, light colored ones I have found more plenty in the corn.

I send you a little box with some specimens.

Yours truly,

N. H. SLEEPER.

LISBON, ME., June 9th, 1892.

TO F. L. HARVEY, ESQ.:

Dear Sir:—I received your letter a short time ago and was immediately called away, hence the delay, and will say that the ground was new land, was in grass for ten years, was never plowed before.

In the fall of 1890, I took out the stumps and stone—large pine stumps and lots of them. In many places the old forest mould was plenty. I think the beetle was a native of such places.

The manure was barnyard scrapings with Clark & Williams' superphosphate. I found no corn cut so low down where the cut-worm was. I found some cut-worms but not many; those that were cut (as I think) by the beetle were cut snug to the kernel or

to the roots of the corn. You remember I wrote you the second letter; in that told you of twenty hills injured. If I remember, was six beetles found; some of them in close to the injured corn, though not quite certain of it. I feel certain he is the fellow that did it. N. H. Sleeper.

From the a' ove evidence it seems certain that the beetles are in part responsible for the injury. This opinion is strengthened by the letters from another locality given below.

Auburn, Me., June 27, 1891.

Prof. F. L. Harvey:

Dear Sir:—I send you by this mail two beetles that we found eating the corn stocks, cutting them off just below the ground in the same manner as the cut-worm. C. V. Manley.

Auburn, Me., May 1892.

Prof. F. L. Harvey,

Orono, Me.:

Dear Sir:—Your letter of the 23d received. The beetles that I sent you last season were found where barn manure was spread on the land and phosphate put in the hill. There were but very few cut-worms on the piece and not any in the hills where we found the beetles.

C. V. Manley.

As this beetle belongs to the same family as the May beetle and others that are found in the larval form in manure, probably it was introduced from that source. As its larvæ is not known nor any of its habits or transformations, nothing can be asserted regarding it. Efforts will be made to procure the larvæ and determine its changes. We know of no remedy better than killing the beetles when found.

Predaceous Water Beetle.

Dytiscus verticalis, Say.

(Ord. Coleoptera: Fam. Dytiscidæ.)

The above species was unusually abundant the last season. Specimens were received from various places and several were found in the writer's yard in Orono, and several specimens caught

by the cats, were taken from them. These insects are water-loving species and are attracted by moisture. Specimens sent by one party were found in the cellar among potatoes. The writer was much troubled by them in his cistern. The water got low and the cistern was filled from the river. The water was not strained and the larvæ probably introduced that way. In a few days the water began to smell and became very offensive. Several of the beetles were taken at various times from the valves of the pump. When water from streams is put in cisterns it should be filtered, and it would be well to keep cisterns closed during the time these beetles are on the wing.

The name *Dytiscus* means a diver and is given on account of the aquatic habits of the larvæ of these insects. The beetles may be known by their oval flattened form, brownish black color with a dull glaucous or sea green tint. The first and second pairs of legs are close together, the hind distant, set far back and used for swimming. The species in question is over an inch and a half long, black above with greenish reflections; thorax margined with yellow; elytra (wing covers) bordered with yellow excepting in front and near the hind margin bearing an oblique narrow yellow band.

The beetles, though larger, are related to the gyrating beetles often seen in large flocks playing on the surface of water and called lucky bugs by the boys. The larvæ are aquatic and are the terror of the ponds and streams, likened to sharks among higher animals.

The Parallel Elaphidion.

Elaphidion parallelum, Newm.

(Ord. Coleoptera: Fam. Cerambycidæ.)

This comparatively rare insect was received from Mr. Burgess of Monroe, in the larval form found boring into the twig of a plum tree. Though of rare occurrence it is interesting enough to figure so it may be recognized when seen.

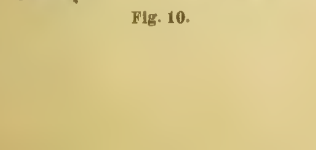


Fig. 10.

Fig. 10 *a* shows the larva, *b* a longitudinal section of the stem exposing the chrysalis in place, *k* a cross section of the chrysalis showing the boring, *d*, *e*, *f*, *g* and

h head and mouth part of the larva, *i* the antenna of the beetle, *j* tip of the wing case. The beetle may be known by its dull brown color. It is a little over a half inch long. The eggs are laid in the axils of leaf buds. The young larvæ bore into the twigs enlarging the channels as they grow and when mature enter the chrysalis state in the stem and in due time emerge as beetles.

The Brown Ptinus.

Ptinus brunneus, Durfs.

Ord. Coleoptera: Fam. Ptinidæ.

The above named family embraces a number of minute species of beetles that do much injury, some boring into fruit trees, others into furniture, while others love animal food and injure hams, museum specimens, leather bound books and clothing.

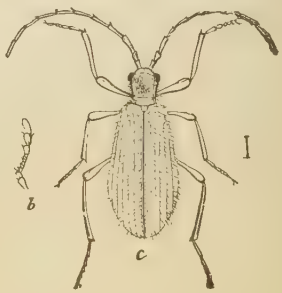


Fig. 11.

The genus *Ptinus* may be known by having the head and thorax much narrower than the wings (elytra); the antennæ about as long as the body, filiform not enlarged or branched. The species *P. brunneus*, Durfs., is only one-eighth of an inch long, dark brown and convex above, thorax narrower behind, densely covered with minute hairs. It is interesting in connection with the correspondence given below. The insect enlarged is shown in Fig. 11, the real size being indicated by the hair line at the right.

Calais, Maine, Jan. 8th, 1891.

To Professor Balentine, Orono:

Dear Sir:—To your address I send by to-day's mail a tin box of red pepper. It has been in our possession since March, 1888. The label, which I did not notice particularly, and unfortunately destroyed when I opened the box, was not removed until recently. The pepper is, as you see, infested with bugs. The box has been subject to all the extremes of our climate, and if the bug would feed upon our vegetation might become a troublesome pest. I hope that I have not foolishly intruded upon your time.

Respectfully,

Mrs. Esther Gardner,
Calais, Maine.

Orono, Me., Feb. 1, 1891.

Mrs. Esther Gardner,
Calais, Me.

Dear Madam:—The box of infested red pepper which you sent to Prof. Balentine proved to be too tearful a subject for his consideration, and was turned over to me. I have wept, sneezed and delayed, but finally have summoned courage sufficient to examine the material and am now able to name the beetles you sent, which possess such strong stomachs and peculiar tastes. I have wondered while I have cried and sneezed, whether they have optic and olfactory nerves as sensitive as mine.

The beetles were probably not in the pepper when you bought it, as they are *Ptinus brunneus*, Durfs., a common, *indigenous* species known to feed upon wood, or sometimes on old books. I believe it has never been reported as feeding on red pepper. It must have found these conditions congenial as there were plump live larvæ of several ages with the beetles in the box. The above species is a brother to Ptinus fur, L., an imported European species that attacks museum specimens and sometimes clothing. The species mentioned with others belong to the Family *Ptinidæ*. Your conscience can be at ease. You have not turned loose in Maine an insect previously unknown to our fauna, for *Ptinus brunneus* is an *American*, besides, he does not aspire to growing vegetation for food but is content with dead vegetable and animal matter.

Yours very tearfully,

F. L. Harvey.

The Goldsmith Beetle.

Cotalpa lanigera.

Ord. Coleoptera: Fam. Scarabæidæ.

This beautiful beetle, which is shown about natural size in Fig. 12, may be known by its broad oval shape; lemon yellow color above, head and thorax glistening like burnished gold; the under side of the body coffee-colored and thickly covered with whitish wool; legs brownish yellow or brassy and shaded with green. The larvæ of this insect is a large grub that feeds upon the roots of plants. It has been accused of injuring strawberries. It is shown natural size in Fig. 13. It requires three

Fig. 12.

years to mature and resembles the grub of the May beetle.

Fig. 13.

Having received several letters accompanied by specimens of this insect, we give below one received the past season, with the reply, for the benefit of others who may need similar information.

Frye, Maine, June 26th, 1891.

State College,

Orono, Maine:

I send a specimen of Beetle which I have never seen before in this State. Please examine it. It is sent in a tin box package.

Yours truly,

Allen Reed,
Frye, Maine.

Mr. Allen Reed,

Frye, Maine:

Dear Sir:—The specimen you send is the Goldsmith-beetle, known to entomologists as *Cotalpa lanigera*, L., Family *Scarabæidæ*. This insect, in the perfect or beetle stage, feeds upon the leaves of trees, especially the pear, though other trees, as the elm, hickory, poplar and oak are subject to its attacks. During the middle of the day the beetles hide in the trees on the under side of the leaves, and are on the wing in the evening and morning twilight. The beetles come out of the ground in May and June. When abundant they do considerable damage to the foliage of trees, but they are so scarce in Maine we need not be concerned regarding them. This beautiful beetle always claims attention when found. We have specimens from the Kennebec valley and farther west in the State, but have never found or heard of a specimen being taken in the Penobscot valley or eastern part of the State. Will be pleased to answer any further questions you may ask regarding insects.

Yours truly,

F. L. Harvey.

Remedies for Borers.

Mr. Rutillus Alden called our attention to an orchard in Winthrop, Me., owned by Mr. Dexter Remick, that was coming into bearing and had been kept entirely free from borers by rubbing

the trunk of the tree with the hand, while other orchards in the vicinity were infested. Regarding the matter of importance, we addressed some questions to Mr. Remick and condense the following facts from his reply: "My trees, Baldwins and Benonies, are five years old and just commencing to bear. They are planted on sandy loam and have been well fertilized with manure about the roots and are vigorous. My orchard is younger than my neighbors'. There are orchards within a short distance of mine. My trees have never been scraped but are naturally smooth and I have never applied any washes to protect them from borers.

I rub the trunks well with the hand twice every season, once in June and again in September. I rub as low as possible and to some height on the trunk." We tried to secure some larvæ of borers from the adjoining orchards, so as to learn which species of borer was common in the region, but did not. Under the circumstances we are not able to decide regarding the efficacy of the remedy. We see no reason why rubbing about the crown and lower part of the trunk would not destroy the eggs or newly hatched larvæ of the *Round-headed Borer*, (see Station Rept. 1888, p. 153.) The trunk would have to be free from crevices and the rubbing done at the right time, to prove effectual. We see no special efficacy in the hand and think a stiff brush would be better. If it is the *Flat-headed Borer* (see Station Rept., 1888, p. 155) that is working in the adjoining orchards and the above species rare, the vigor of the trees would protect them, as this borer usually prefers sickly trees, and as it lays its eggs on the *branches* as well as *anywhere* on the trunk, rubbing the base of the trunk would not protect the tree. We hope to get some of the larvæ this season.

We have noticed somewhere another remedy that seems to be simple and apparently practical for the *Round-headed Borer*, viz: to dig away the dirt an inch or two at the base of the tree, then tie around it a piece of thick paper, allowing it to extend a foot or more up the trunk; then put the dirt back. This arrangement prevents the beetle reaching the crown to lay its eggs. The paper should be left on the tree during the time the beetles are on the wing, that is from June to August. The paper could be poisoned with Paris green. Wrapping in this way is also advised to protect trees from rabbits.

BREEDING STATISTICS.

Dr. F. L. Russell.

The material for these statistics was obtained by sending out blank forms to farmers all over the state. The animals reported on were grades and full bloods of all the more common breeds of cows and also comprise a large proportion of "natives."

It is evident that the value of such statistics as these depends upon the number of animals upon which they are based, and the accuracy of the data. We make this brief report from the material at hand, hoping that it may awaken such an interest in the subject that a larger number than have heretofore done so will fill out and return to me the blanks that will be mailed them each year. This is a matter of general interest to farmers and stock breeders and we would urge upon them the importance of filling out the enclosed blanks as fully as possible. It is desired that the weight of the calves shall be taken within twenty-four hours of birth. Where conveniences are not at hand for doing this, that item may be omitted, as an estimated weight is not sufficiently accurate. We particularly desire that the last item on the blank should be carefully considered. We would decide the period of heat so as to include six or eight hours in the first part, the last six or eight hours in the last part, and the rest we would regard as the middle part of heat.

The reports that have already been received indicate that there may be some relation between the time of service and the sex of the calf. If this should prove to be true, it is a matter of considerable importance and we desire that great care be taken to correctly record the time of service.

The average period of gestation for 257 cows reported was three and one-half hours over forty weeks or 281.72 days. For the bull and heifer calves the average time was practically the same, for the bulls 281.74 days and for the heifers 281.69. The shortest period, 243 days, resulted in a heifer calf. The two longest periods were 303 and 304 days and the calves were both bulls. Of the 257 calves 135 were bulls and 122 heifers.

Of the 113 calves of which the weight at birth was given, the average weight is found to be 73.62 lbs. The average weight of

Report of Botanist and Entomologist.*

Prof. F. L. Harvey.

Prof. W. H. Jordan.

Dear Sir:—I have the honor to submit herewith my fifth annual report as Botanist and Entomologist for the Experiment Station. Judging from the number of letters received the past season, asking questions about plants, insects, fungicides and insecticides, there is an increased demand on the part of farmers in the State, for information upon Economic Botany and Entomology. Below will be found tabulated the more important plants and insects that have received attention during the past season. Those requiring more than a passing notice are considered in detail, and so far as necessary illustrated.

The past season has been somewhat remarkable because of the appearance in the State in injurious numbers of several insects that have not before been reported, viz: The Corn or Boll worm, which was found in the vicinity of Farmington feeding on sweet corn; the Chinch Bug, doing great damage to grass grounds in the vicinity of N. Fryeburg; the Horn Fly which proved quite annoying to cattle in the western part of the State, and *Bruchus obtectus, Say*, the Bean Weevil, boring in stored beans after the manner of pea weevils in peas.

We stated in our report for 1891, that the Fall Canker Worm had been increasing in the Penobscot valley for the past four years, and that considerable trouble might be expected from it in the future. It has proved very troublesome the past season about Winterport, Bowdoinham and Stockton, doing great damage to fruit and shade trees. We learned through a Vermont correspondent that the Apple Maggot, *Trypeta pomonella*, Walsh, infests pears in that State. As we have never seen it working in pears in Maine any information on the subject from Maine orchardists will be appreciated. We received specimens of the Melancholy Cetonia (*Euphoria melancholica,*) from Mr. John A. Smedberg, Unity, which were eating sweet corn at the top of the ear. So far as we know this habit has not been recorded. The Oyster-Shell Bark-louse must be doing great damage in Aroostook County

*Papers from the Maine Agricultural Experiment Station: Entomology No 7.

judging from the badly infested specimens of apple twigs received from David Crane of Houlton. Those interested in this insect will find it considered in Expt. Sta. Rept. 1888, p. 157.

The Three-toothed Aphonus, accused of cutting corn in our last report, has been fully convicted of the charge the past season, by Mr. C. V. Manley of Auburn. He says, "I found this beetle which I send you, in a hill of corn with his head in a cut in the side of a stalk that had begun to wilt."

Mr. E. W. Merritt of Houlton, reports that he keeps the plant lice on his gooseberry bushes in check by removing the twigs bearing curled leaves in the fall. We have received insects during the past season from Illinois and California sent for determination by the editor of the Maine Farmer. Investigation of a species of mite called by us the Two-spotted Mite has been continued. This mite has done considerable damage the past season in the greenhouse at the college, and we found it had almost entirely destroyed a patch of German Wax Beans in our garden. Should it prove able to injure to any extent out of door plants, its capabilities of doing damage would be greatly enhanced. As we were doing laboratory work on the mite, it might have been carried to the beans on our clothing. We wish to study the coming season, insects affecting currant and gooseberry bushes, and will be pleased to receive specimens from all parts of the State.

We received from Mr. Ira Porter, Houlton, Maine a bunch of clover, *Trifolium medium*, L., in which the heads had assumed the form of conpound umbels. This was interesting as a confirmation of the belief by botanist, that the head, a kind of inflorescence found in the clover, is an umbel with the axis of inflorescence and the pedicils, shortened. Mr. Henry Sprague of Charlotte, for whom we examined some mosses last season in reference to their value as food for swine, reports that he fed during the winter about six barrels of *reindeer moss*, four of *hypnum splendens*, two of *sphagnum cymbifolium*, to three *swine*.

As the pigs all had other food he had no definite way of telling how much nutriment they got from the mosses. Thinks they liked either of the others as well as the reindeer moss. Thinks all had a constipating effect, which he overcame by liberal doses of sulphate of magnesia (salts).

Mr. W. H. Burgess of Monroe, says, that he grafts the Arctic and Lombard plums into the common Pomgranite and avoids the black knot, which has proved so destructive to plum trees in general. We don't know how thoroughly the experiments were tried, but

have serious doubts about its being a protection. We doubt whether any of the varieties are exempt from this disease, though we admit that such a variety would be a great blessing to plum growers. We received from Mrs. Myra Damon, Newport, Maine, a specimen of Stinkhorn found in a cistern. These plants grow in decaying organic matter and are often found about sink spouts, drains and other places where decomposing organic matter occurs. They may be known by their curious habit of growth. At first they look like a puff-ball, finally the top bursts and from it comes a large spongy stipe which bears at the apex a slimy mass of brownish offensive spore bearing matter. The bottom part (utricle) of the form sent is about as large as a filbert, the stipe pink and three or four inches long. Finding it about the cistern would lead one to suspect that a sink spout or drain was too near, and that the water might be contaminated by it. These fungi are poisonous, but a single one in a cistern would not render the water harmful. Too great care cannot be exercised in placing drains and sink spouts where they cannot possibly contaminate water supply, as decomposing organic matter in drinking water is a very common source of diseases.

Samples of sage sent by Mr. Willard Lothrop, of Leeds Centre for examination as to adulterations, proved to be free from foreign matter, but were composed largely of old stems and poorly cured and blackened leaves. As to color and richness of flavor, the material was quite inferior, and would give dark color and poor flavor to sage cheese.

Walter M. Haines M. D., of Ellsworth, sent us some specimens of Fresh water cord Grass, and asked whether they were not Wild Rice. Wild Rice was sown quite largely in the marshes and ponds of Maine some years ago to attract water fowl, but so far as we know it has not become established in the State. If any one knows of its occurrence in the State, we would be glad to learn the localities. Mr. Fernald gives it in his Portland Catalogue as indigenous to the State, but we do not know the locality.

The Orange Hawkweed is spreading rapidly in the State and threatens to be a serious pest in meadows and pastures. Farmers should study the description given in this report, and be prepared to recognize the pest as soon as it appears, and destroy the straggling plants before they form large patches hard to manage. Below we give an extended account of the most important plants that have claimed attention during the past season.

The Potato Rot has been quite bad in the State the past season. We hope that potato growers will see the importance of using Bordeaux mixture to hold this disease in check. It has proved a great help in other States when applied at the time, or just before the disease makes its appearance.

Remarks.

The cuts and plates to illustrate this report were obtained from the following sources: from the Department of Agriculture, Washington, D. C.; Cuts of the Orange Hawkweed, and of the Horn Fly. From Prof. S. A. Forbes, cuts of the Corn Worm and Chinch Bug. From Prof. F. D. Chester, cuts showing the results of spraying against Pear Leaf Blight. Plate II. is original.

Directions for sending specimens will be found in the Annual Report of the Experiment Station, 1888, p. 194, or in Maine Agricultural Report, 1888, p. 158. Correspondence regarding injurious insects and fungi is invited. Insects and plants will be named, and when injurious, remedies suggested. It is to the interest of farmers to detect injurious insects and fungi before they become established, so that remedial measures can be adopted before the pests are beyond control. As the Entomologist's duties prevent him from going much about the State, it is largely through correspondence that the Station learns of insects doing injury in the State.

No.	Common Name.	Technical Name.	From Whom Received	Remarks.
1	Cecropia Emperor Moth.	Platysamia Cecropia, Linn.	Ross C. Higgins, Thorndike. M. H. White, Bowdoinham.	Cocoons attached to branches of apple trees. See Ex. St. Rept. 1890, p. 121.
2	Fall Canker Worm.	Anisopteryx pometaria, Harris	M. H. White, Bowdoinham. Hon. F. Atwood, Winterport. Freeman Partridge, Stockton.	Eggs attached to apple trees, larvæ upon foliage, male and female moths about orchard. See Ex. St. Rep. 1888, p. 166.
3	Fall Web-worm.	Hyphontria cunea, Drury, = H. textor, Harris.	Ross C. Higgins, Thorndike.	Foliage of apple trees making a web at the ends of the branches. See Ex. St. Rept. 1890, p. 124
4	Corn or Boll-worm.	Heliothis armigera, Hub.	J. M. S. Hunter, Farmington. D. H. Knowlton, Farmington.	Boring through the husks and eating the kernels from the cobs of sweet corn.
5	Melancholy Cetonia.	Euphoria melancholica, Gory.	John A. Smedburg, Unity.	Eating sweet corn at the top of the ear.
6	Three-toothed Aphonus.	Aphonus tridentatus, Say.	C. V. Manley, Auburn.	Cutting off stalks of sweet corn in the hill. See Ex. St. Rept. 1891, p. 199.
7	Plum Curculio.	Conotrachelus nenuphar, Herbst.	H. T. Cummings, S. Paris.	Pears badly punctured by this insect. See Ex. St. Rept. 1888, p. 178.
8		Pasimachus species.	Ross C. Higgins, Thorndike.	On the ground; a beneficial species feeding on other insects.
9	Scabrous Osmoderma.	Osmoderma scabra.	Ross C. Higgins, Thorndike.	Found on an apple tree. Larvæ bore in apple trees.
10	The Squash Bug.	Anasa tristis, De Geer.	S. Dill, Soquel, Cal.	Feeding on squashes.
11	The Chinch Bug.	Blissus leucopterus, Say.	W. B. Nutter, B. Walker McKeen, Simeon Charles, N. Fryeburg.	Destroying Timothy meadows.
12	Currant Worm.	Nematus ventricosus, Klug.	H. H. Osgood, Blue Hill.	Eating foliage of currant bushes. See Ex. St. Rept. 1888 p. 182.
13	Oyster-shell Bark-louse.	Mytilaspis pomorum, Bouché.	David Crane, Houlton.	Badly infesting the branches of apple trees. See Ex. St. Rept. 1888. p. 157.
14	The Horn Fly.	Haematobia serrata.	Hon. B. W. McKeen, Augusta.	Troublesome to cattle.
15	Two-spotted Mite.	Tetranychus 2-maculatus, n. sp.	Prof. L. H. Bailey, Ithaca, N. Y., and others.	A bad pest in hot houses and also affecting house plants and sparingly out of door plants.
16	Wood Louse, or Sow Bug.	Porcellio species.	Henry Ruffe, Orono.	Mistaken for the Buffalo Carpet Beetle. Lives on decaying wood and organic matter.
17	Long Horned Wood-borer.	Monohammus titillator, Fabr.	O. F. Brigham, Newport.	A wood borer.

Plants Received for Examination—1892.

No.	Common Name.	Scientific Name.	From Whom Received.	Remarks.
		WEEDS.		
1	Fall Dandelion.	Leontodon autumnale, L.	Henry Norcross, Augusta.	Weed in meadows.
2	Orange Hawkweed.	Hieracium aurantiacum, L.	Geo. W. Chamberlain, Calais. H. L. Leland, E. Sangerville. G. S. Paine, Winslow.	Weed—meadows, roadsides and pastures.
3	Canadian Hawkweed.	Hieracium Canadense, Michx.	I. T. Merrill, China.	Border of fields; not a bad weed.
4	Knapweed.	Centaurea nigra, L.	I. T. Merrill, China.	Weed in fields; should be looked after.
5	Rabbit-foot Clover.	Trifolium arvense, L.	I. T. Merrill, China.	Weed—roadsides, etc.; very common in Maine.
		GRASSES.		
6	Red Top.	Agrostis alba, L. Var. vulgaris, Thurb.	S. H. Berry, Wayne.	Sold by Parker & Wood, Boston, as Kentucky Bluegrass, (*Poa pratensis*, L.)
7	Freshwater Cord-grass.	Spartina cynosuroides, Willd.	Walter M. Haines.	Sent to learn whether it was wild rice.
8	Orchard Grass.	Dactylus glomerata.	Joseph F. Warren, W. Buxton.	Growing in grass ground.
		FUNGI.		
9	Pear Leaf Blight.	Entomosporium maculatum, Lev.	Arthur D. Moore, Portland.	Parasitic on leaves of pear trees causing them to curl, turn red and drop; a bad disease.
10	Hair Mold.	Phycomyces nitens.	N. H. Martin, Fort Fairfield.	Growing on excrement of cats in a potato hill. Not of special economic importance.
11	Anthracnose.	Glæosporum venetum, Speg.	Chas. S. Pope, Manchester.	Raspberry bushes badly infested.
12	Anthracnose.	Glæosporum venetum, Speg.	H. H. Osgood, Blue Hill.	Affecting Shaffers Colossal Raspberry.
13	Stinkhorn.	Mutinus Ravenelii, (B. and C.) Fisch.	Mrs. Myra Damon, Newport.	Found in a cistern. An offensive, poisonous species.
		MISCELLANEOUS.		
14	Zigzag Clover.	Trifolium medium, L.	Ira J. Porter, Houlton.	Heads changed to compound umbels Flowers malformed and dwarfed.
15	Golden Rod.	Solidago squarrosa, Muhl.	E. F. Hitchings, Bucksport.	Sent for verification.
16	Golden Rod.	Solidago latifolia, L.	E. F. Hitchings, Bucksport.	Sent for verification.
17	Aster.	Aster acuminatus, Mx.	E. F. Hitchings, Bucksport.	Sent for verification.

BOTANY.

Fall Dandelion.

Leontodon Autumnale, L.

(Ord. Compositæ.)

The above species continues to be reported as troublesome in grass lands. It has a firm hold in the State, and should be known by farmers so they can check it before a whole field is overrun. When there are only a few plants, the extermination is a simple matter, but if neglected serious trouble will follow. Much of the clover seed offered for sale in this State contains the seed of this weed.

The following reply to Mr. Henry Norcross may interest others.

Mr. Henry Norcross of this city, brought a specimen plant to this office for identification. He says his fields are infested with it, and that it is killing out the grass far and near. We forwarded the sample to Prof. Harvey, Botanist at the Experiment Station, who kindly forwarded the following to the *Farmer:*

The plant you enclose for determination belongs to the sunflower family (*Compositæ*) and is called by botanists, *Leontodon autumnale, Linn.* Its common name is Fall Dandelion. The Latin name means the *Liontooth that blooms in the autumn.* The leaves are incised, suggesting the name of liontooth. The plant is a native of Europe, but is thoroughly naturalized in the United States, and quite widely spread. It is especially plentiful in New England, and a bad weed. Being an abundant seeder and a perennial, it is hard to exterminate. It grows under the most unfavorable circumstances, and will replace grasses in meadows. Should it become too abundant, there is no way to destroy it excepting cultivation in some hoed crop until it disappears. The plants about roadsides, edges of fields and lawns, should be pulled by the roots, or kept from seeding by careful mowing. In this region it is abundant along the roadsides, and is increasing. Occasionally a field is noticed nearly overrun with it. Roadsides are prolific seed gardens that supply the public gratis with an abundance of seeds of the vilest weeds. The town authorities should be empowered by law to exterminate patches of weeds that appear, and might become the centres of distribution of troublesome pests. This weed will be found figured and described in Experiment Station Report, 1890, p. 120.

F. L. Harvey,

Botanist for the Station.

Orono.

Orange Hawkweed.

Hieracium aurantiacum, Linn.

(Ord. Compositæ.)

The following letters were received the past season at the Station regarding the above plant. They show how rapidly the weed is spreading, and what a bad pest it is regarded by farmers. The plant has been found in limited quantities on the College farm in a pasture near the river, and has not spread very much in that place but the past season we noticed it in several places in the meadow land. Mr. James Walker of Bangor, reported a field of several acres near Pea Cove, nearly overrun with it. Mr. George W. Chamberlain reports it from Calais. These together with the localities given in the following letters show it is widely distributed in the State. The question so pointedly asked by Mr. Paine, whether "*we are at the mercy of our neighbors in the matter of spreading weeds*" is one that should seriously claim the attention of the legislature. There should be a law preventing farmers from harboring vile weeds in their fields or letting them grow at the roadsides on their premises. On property for which no one is especially responsible, the dangerous weeds should be eradicated at public expense. Why do not farmers urge some enactment for their protection? There should be a law subjecting seed sold in the State to inspection. The character of the seed sown is as important as the composition of the fertilizer used.

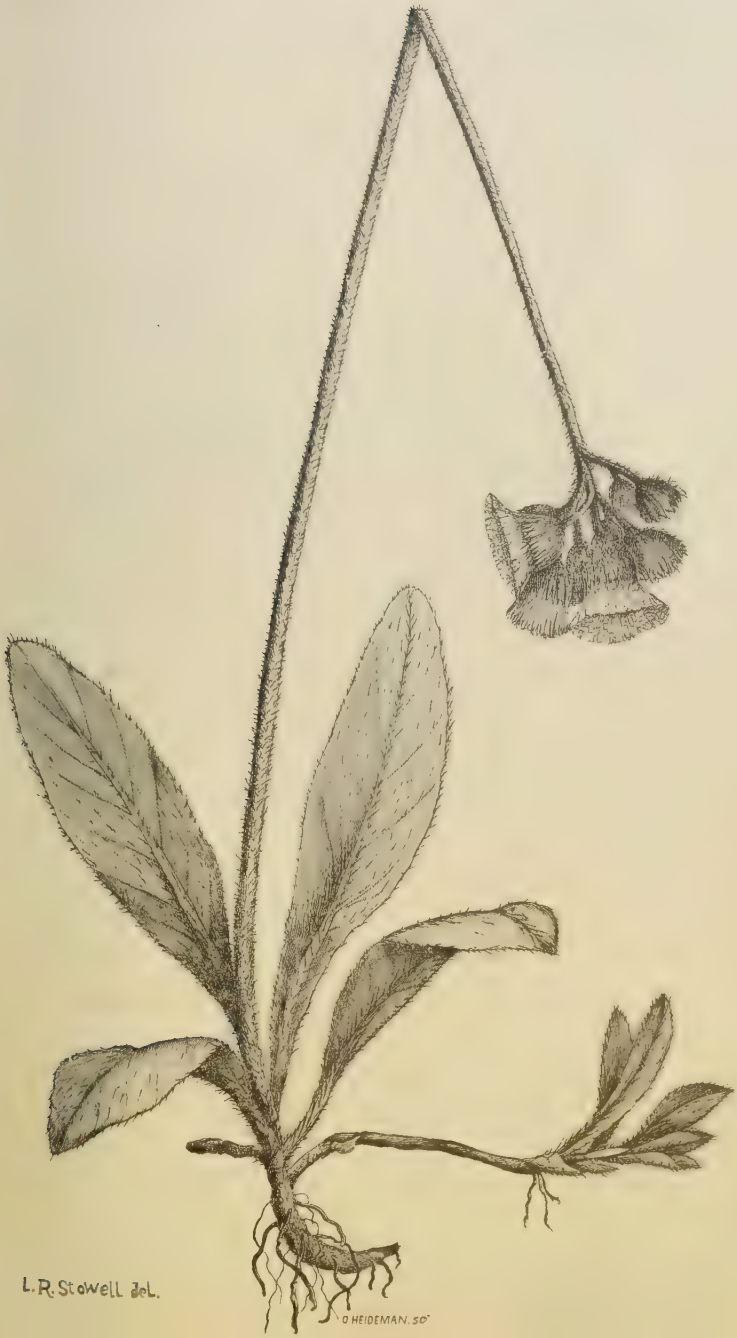
Winslow, Me., June 20, '92.

The State Agricultural College,

For the Prof. of Botany,

Orono, Me.

Dear Sir:—About two years ago I sent you, I think, a plant found in this vicinity which you identified as the Orange Hawkweed. It was not regarded as a dangerous weed at all. I wish to give my experience with it and ask if there is any way to compel farmers to stamp out such weeds under our law. I have fought it on this farm for about five years. It comes from a farm one-fourth miles square, two narrow farms intervening, and these farms are getting rapidly stocked with it. I have watched it with the greatest care and have picked it clean the middle to the last of June, and again scoured the fields after the haying and at frequent intervals till fall. In spite of the greatest care it is



ORANGE HAWKWEED

gaining on me, and when these other farms are well covered I shall have to give it up. I am surrounded by the wild carrot, and have no difficulty in keeping it off the farm, but the Hawkweed, one of the vilest to the smell, seems almost impossible to eradicate. In my opinion, if its behavior indicates anything, it is the most dangerous weed that has threatened us, not excepting the Canada thistle. Will you be kind enough to inform me if we are at the mercy of our neighbors in the matter of spreading such weeds? A line from you will greatly oblige

Yours very respectfully,

G. S. Paine.

East Sangerville, Me., July 1, 1892.

Brother Balentine:

Find enclosed a plant (weed) that is rapidly encroaching into fields and pastures. It is known locally as *Missionary* weed. Its mission however is one not to be desired. The weed is described in the Report of the United States Department of Agriculture 1890 under the name Orange Hawkweed. This plant is rapidly spreading in the county from many different points. A recent trip in the town of Guilford and Foxcroft showed many fields completely overrun. The village streets and numerous grass flats in Foxcroft village are painted red with this weed. In fact it is a *monopoly* plant taking full possession of the soil, and destroying everything else. Do you know whether the weed is common in the State? It seems to me it cannot be, as I do not remember to have seen anything said of it in the Agricultural papers. Can you or any of your associates tell us how successfully to fight it? If you know aught of it, and methods of eradication please give them to me for publication in the Piscataquis Observer.

The rapidity with which this weed is taking possession of our fields is alarming to our farmers.

Truly, H. L. Leland.

Remarks.

This weed has recently been introduced into the Eastern United States from Europe. It has been in Maine on the College farm for at least ten years, and according to Mr. Paine, about Winslow for more than five years. We have no knowledge of the time or place of its introduction in the State. Such things are scarcely ever noticed until they do injury, when it is often too late or very troublesome to eradicate them. The experience of Maine farmers

shows that the plant does not confine itself to roadsides and pastures, where the grass is short, but encroaches into meadows and overruns them. The plant being a perennial and developing runners and root-stocks, makes it a very difficult weed to control. Nothing short of destroying the roots will suffice. Besides, it is so hardy and tenacious of life that it takes almost complete possession of the soil. It is prolific of seeds, which are provided with a row of bristles (pappus), giving it the power of wide dissemination by the wind. We will be pleased to hear from anyone who has noticed this weed and to learn how long it has been known or anything regarding its introduction in the State. On the opposite page we give a cut of this weed and below a description, both copied without change from the United States Department of Agriculture, Report for 1890. They will enable anyone to recognize this vile weed.

"Perennial by slender root stocks and by runners; Stem simple, erect, one to one and one-half feet high, nearly leafless, densely hirsute, the hairs toward the apex of the stem black at the base; leaves mostly radical, oblong-lanceolate, denticulate, hirsute on both sides, sessile, those of the stems two or three; all but the lowest reduced to bracts; heads in a bracted cyme; peduncles with black, glandular hairs and a close brown coating of stellate hairs; involucre about one-third of an inch in diameter, its bracts linear-lanceolate, little imbricated, provided on the back with straight, glandular and stellate hairs; flowers all perfect, with ligulate orange-covered corollas; achenia about one line long, darkbrown, linear in outline, terete, ten-ribbed, truncate; pappus a row of dirty white bristles."

Leaf Blight of the Pear.

Entomosporium maculatum, Lev.

Attention has been called to the above fungus as doing damage to the leaves and fruit of pear trees in Maine.

The letters from Mr. Moore given below will indicate the nature of the inquiries. Mr. Moore's pear trees are located upon Diamond Island, Portland Harbor.

May 24, 1892.

Horticulturist Maine Experiment Station.

Dear Sir:—I enclose a few leaves from my Clapp's Favorite pear tree.

The leaves began to have this appearance two seasons ago, on one branch of the tree. Last year more branches were effected, and this year it seems to have spread over the whole tree. Is it Pear blight? and is there any remedy?

Yours Respectfully,

Arthur D. Moore.

The above letter shows how rapidly this disease spreads, and the necessity of applying remedial measures as soon as possible. We recommended the use of the ammoniated carbonate of copper solution, made as follows:

Dissolve three ounces of carbonate of copper in two quarts of commercial ammonia water (22°) and dilute with water to thirty-five gallons.

Fig. 1. *Tree not sprayed.*

The first application should be made when the leaves are half grown and repeated according to the severity of the case every three or four weeks during the season.

Fig. 2. *Showing beneficial effects of spraying.*

The experiments made by Mr. Chester of the Delaware Experiment Station, in 1891, show that the carbonate of copper and carbonate of ammonia solution is cheaper, as well as one of the most effective of the copper compounds used as fungicides. It is made as follows: Mix three ounces of carbonate of copper with one pound of pulverized carbonate of ammonia; dissolve in two quarts of hot water and dilute further with water to fifty gallons. Figures 1 and 2 show the relative condition of sprayed and unsprayed trees.

Mr. Moore made the following report:

Jan. 3, 1893.

Prof. F. L. Harvey,

Dear Sir:—Yours of the 27th at hand. I sprayed my pear trees with the ammonia and copper carbonate solution, according to directions as nearly as possible, June 13 and again July 16.

The fungus had already appeared when the first application was made, but it did not spread nor seem to kill the leaves as much as the year before. The leaves remained upon the trees this year until the usual time, whereas in '91 that part of the tree affected was entirely bare for a month before it should have been. I think the spraying has been of great benefit and will eventually cure the disease.

I thank you very much for your kindness to me, and for the interest you have taken in the matter. I also wish to thank you for the reports which you so kindly sent me. I have enjoyed them very much and have found much in them of value to me.

I will write you again in regard to the pear trees when the leaves appear next spring.

Yours respectfully,

Arthur D. Moore.

P. S. The spraying seemed to stop the disease just where it was. In '91 it spread all over the leaf and seemed to burn it all up, so that they were all dead by the last of August.—A. D. M.

Characters of the Fungus.

This fungus causes a premature discoloration and dropping of the foliage and in some cases the spotting and cracking of the fruit. It has done considerable damage to pear and quince orchards. It does not seem to be as bad in Maine as in the Atlantic States farther South, but it is here and should be known and precautions taken to prevent its spread. Sometimes the leaves all drop early, but usually they drop slowly during the season. The leaves are unhealthy, the trees do not make a normal growth and sometimes a second blossoming occurs.

The disease first shows itself in the form of minute red spots, which increase in number and size and finally cause the leaf to shrivel and drop. The tender twigs are affected and often destroyed. The disease upon the fruit causes it to crack, through which germs enter and cause early decay.

Black or Hair Mold.

Phycomyces nitens.

We received the above-named fungus from Mr. Martin, and as the species is quite common in Maine we give Mr. Martin's letter and an account of the plant.

Fort Fairfield, Me., March 31, 1892.

Friend Jordan,

Dear Sir:—Enclosed with this letter you will find a piece of an elephant potato, to which is attached a hairy mane.

In the same hill there grew seven potatoes, all of which had a hirsute growth similar to the enclosed.

Will you please let me know whether this is the much-sought-for missing link, or what it may be?

This has elicited much curiosity and we would like to know of what nature it is.

Respectfully yours,

N. H. Martin.

The above-named mold belongs to an order of fungi known as *Mucorini* or *Black Molds*. The species of the genus *Mucor* are quite common on decaying organic matter and are frequently seen on rotten potatoes, squashes, pumpkins and other vegetables in the garden and in the cellar. They also are very annoying to housewives, appearing quickly upon bread, or cooked vegetables

kept in warm, moist places. They may readily be known by their smoky black color, and the dense, erect coating of fine thread-like fibres with which they cover the substance attacked. These fibres bear at the ends small, round head like fruits, that are filled with small, oblong bodies called *spores*, capable of reproducing the mold. Where the fibres cross, spore-bearing bodies are also produced by a sexual process called conjugation. These spores have great vitality and will grow after they have been dried a long time. This accounts for their being everywhere. The spores are light and can be carried a long way by wind. A dry atmosphere is always prejudicial to their growth. The specimen sent by Mr. Martin is not a *Mucor*, but belongs to the genus *phycomyces* of the same *family*. It is quite common in Maine, but prefers oily instead of starchy substances to feed upon. We have frequently found it upon the excrement of cats, which was buried in dirt, or spent ashes out-of-doors, or more commonly in cellars that cats have access to, or under out-houses. The fibres of this plant are sometimes six or eight inches long and in dark cellars a beautiful, glossy black and wonderfully like hair in appearance. The specimens grown in more light, or in the laboratory, are less luxuriant and paler colored. The common species of *Mucor* are much smaller and shorter fibred. The spores of specimens kept in a dry laboratory for five years, germinated readily on bread in a moist chamber. This species of *phycomyces* showed streaming of cells contents (cyclosis) very nicely in a double current along the walls of the cells which joined at the end and flowed back down the centre.

The origin of the specimens sent by Mr. Martin was plainly the excrement of some animal that had been buried in the potato hill. The specimen submitted was growing on excrement, not on a piece of potato. If the potatoes of the hill were affected the fungus originated in the excrement and spread to them. This fungus is interesting, and is sure to attract attention, though it is not to be regarded as especially injurious.

Anthracnose of the Raspberry and Blackberry.

Glœosporium venetum, Speg.

Mr. Chas. S. Pope, of Manchester, Me., sent us the past season a bundle of raspberry canes badly infested with the above disease. He said: "My bushes are all dying with this disease.

They were obtained from a neighbor, who had them from Anderson, of N. Y. I find that my neighbor's are also dying with the same disease." Mr. H. H. Osgood, of Bluehill, reports the same disease as affecting his bushes of *Shaffer's Colossol* raspberry.

History. This disease was first considered by Prof. Burrell under the name "Raspberry Cane Rust," but it is now generally known as *Anthracnose*. It is a foreign species, but has become widely distributed in this country and does much damage to raspberries and blackberries.

Characters. It attacks the canes, leaves, petioles of the leaves, and in some cases the fruit. It attacks both the fruiting and non-fruiting canes. It first appears near the base of the canes as small, purplish spots. As the disease advances it encroaches upon the tops, and in the last stages will attack the petioles, leaves and fruit. The purplish spots enlarge and finally coalesce, producing irregular, light-colored, blister like patches, often over an inch long and sometimes encircling the stem, producing the same effects as girdling with a knife. The leaves and fruit are much dwarfed from a want of nourishment and finally the plants die. The disease lives over winter upon the young canes attacked and renews its ravages the next season.

The fungus producing these effects is a microscopic, internal, thread-like parasite, that creeps between the cells of the host plants, sapping their vitality. It does not usually enter the pith, but confines its ravages to the cells of the bark and cambium layer, causing them to shrivel and die. Near the centre of the diseased spots, where the ends of many of the capillary threads of the fungus meet and unite, are formed masses of short, club-shaped bodies called *basidia*. These are formed under the epidermis of the bark and finally burst it, appearing enveloped in a globule of gelatinous matter. Upon the ends of these basidia are borne singly, small, colorless, oblong, or oval celled bodies called *spores*. The spores are the reproductive elements and serve to spread the disease to adjoining plants and patches. The spores are held together in the gelatinous matter, which is soluble in water. The spores are liberated during rains and rapidly germinate in drops of water on the plants. Dry weather prevents the spread of the disease to new places, though the fungus will continue to grow in dry weather on canes where it is established. Spores liberated by rains are in a condition to be blown by the

wind after the rainwater evaporates. Spores taken from specimens kept in the herbarium for several months will germinate, showing the vitality of this parasite, and warranting the belief that the fungus will live over winter in the canes.

Precautions.

(*a.*) In the case of Mr. Pope's plants the disease was no doubt on the canes when planted and probably on his neighbors' bushes when they came from the nursery. We reiterate the importance of carefully examining nursery stock before planting it, to see whether it is affected by fungus or insect parasites. If found to be affected by a fungus it should be burned without delay.

(*b.*) As it seems quite certain that the spores of this disease survive the winter in old canes, those that are through bearing, or dead, or badly affected, should be removed at the close of each season and burned.

(*c.*) As moisture favors the growth of fungi the plants should be trained and framed so as to admit as free a circulation of air and light as possible. Planting in rows six feet apart and the plants five feet in the rows will admit plenty of light and air, and will admit of cultivation each way.

(*d.*) Spraying with a solution of sulphate of iron (green vitril) two pounds, to five gallons of water, before the buds start in the spring has been recommended.

(*e.*) Should the disease appear after the leaves are expanded the use of Bordeaux mixture is recommended.

Remarks.

Those who wish to read a fuller account of this disease will find it considered in the Report of the U. S. Department of Agriculture, 1887, page 357, and illustrated on plate V.

The Potato Blight.

Phytophthora infestans, De Bary.

To determine whether the germs of potato rot live over winter in the soil, or are planted in the seed, the following experiment was performed:

A quantity of rotten potatoes from a badly infested patch was gathered and buried in the ground under as natural conditions as

possible. The next spring, two lots of seed that had shown no evidence of rotting in the cellar, were selected and planted as follows:

1. Two rows, one of each kind of seed, on the ground where potatoes rotted badly the past season.

2. Two rows one of each kind of seed upon land that had not grown potatoes for two seasons.

3. Two rows planted as in lot 2, but each hill infested with the rotten potatoes buried the fall before.

All the rows were fertilized alike with phosphates and ashes.

Results.

The disease did not appear in any of the rows.

This would indicate, so far as one experiment goes, that the germs do not survive the winter in the soil, and would emphasize the importance of selecting seed free from the rot. We are not satisfied with the results and will repeat the experiment.

Bordeaux Mixture for the Rot.

Mr. B. Walker McKeen has experimented with Bordeaux Mixture the past season, to prevent potato rot and we give below his interesting and suggestive report.

AUGUSTA, Dec. 31st, 1892.

DEAR PROF. HARVEY:

In reply to your favor of yesterday, asking for my experience with the Bordeaux Mixture for potato blight, I will say, that I used the mixture quite thoroughly through the entire season, putting it on three times, but the results were not such as to warrant me in recommending it to farmers without another trial. I raised a very fine crop of potatoes, all of good size, and the rust did not affect them to any great extent. Still there were some other pieces quite near me that were not affected materially. Other pieces suffered quite badly. I am inclined to the belief, that a *liberal fertilization* of the ground for potatoes will tend to place them beyond the reach of the rust, and that in this way farmers may prevent its ravages, in a great measure. Still I am prepared to say that I shall *certainly* use the mixture another year, as I am not yet prepared to condemn it, as I certainly think my crop was increased by its use. I hope to be able to report more fully after another trial.

In addition to my own experience, I might say that I furnished a neighbor material enough to put upon a small part of his piece and that he used it but once, and he is willing to say that the tops where the mixture was used remained green much longer than those which had not been treated, the difference being so great that the neighbors in passing stopped to learn the cause; but the difference in the crop was not what he expected it would be, from the looks of the tops. He will use it largely next season.

Yours very truly,

B. Walker McKeen.

In reference to the plan of liberal fertilization suggested by Mr. McKeen, it is well to remember that a patch of potatoes may be destroyed by potato blight in *two* ways. The germs of the disease may be in the seed, or in the soil upon which the potatoes are planted. In either case the germs would soon enter the young plants, grow with them and finally destroy them. In the second case the soil and seed may be *entirely free* from germs and the crop almost reach maturity and then becomes infested by *summer spores* blown from an adjoining patch and rapidly destroyed.

It is a principle, equally applicable to plant and animal life, that healthy specimens (all other conditions being equal) are stronger and better able to resist the attack of diseases and parasites. It is also a good rule to fertilize highly and feed animals well for by so doing the profits are greater.

It must be also remembered that plants under cultivation and animals under domestication make a more rapid growth than in nature, and that their tissues are much softer, and when once attacked by a fungus or parasite they become an easier prey.

If the higher fertilization of potato land will hasten the maturity of the crop, and thus prevent infection from the poorly fertilized lands of a shiftless neighbor, it would be an advantage.

If the germs are already in the patch, high fertilization would make the plants more succulent and give the disease a better hold.

An overgrown patch would also fall an easier prey to summer spores should they reach it at the right time.

We believe it is better to adhere to the rule, that *adequate fertilization is always best* and prepare ourselves to fight the parasites that are sure to attack the soft tissues of cultivated plants. The planting of early varieties would be an advantage, providing our neighbors grow the later sorts.

Bordeaux Mixture cannot destroy the potato rot in plants where it is established. It can only prevent the disease *spreading* by destroying the summer spores.

In experimenting with Bordeaux Mixture some rows in the patch should be left unsprayed to serve as a check.

Bordeaux Mixture is a fungicide of great promise and we hope others will try it and report the results.

ENTOMOLOGY.

Fall Canker-worm.

Anisopteryx pometaria, Harris.

(Ord. Lepidoptera: Fam. Phalenidæ).

This insect is increasing rapidly in the State. We have spoken in previous reports about its increase in Penobscot County, but it is also increasing in other counties. Mr. Freeman Partridge writes that it has done great damage about Prospect in Waldo County. Mr. C. A. Arnold, Arnold, Me., says: "They are the curse of my young apple trees, doing more damage to them by destroying the leaves and blossoms than all other insects combined." The shade and orchard trees about Orono were badly infested the past season. The garden fences in some parts of Orono were literally covered with egg clusters. As the insects feed largely on the tall elms and other shade trees and forest trees, there is no hope of exterminating them by confining our remedial measures to the orchard. We must take steps to keep them out of shade trees or they will continue to breed there and transfer their depredations to the orchard.

Mr. Partridge says the Canker-worms have troubled him for three years, increasing each season. Though the spraying done did not kill the Canker-worms it did destroy the *Codlin Moths*. He says he did not find a bushel of apples affected by this insect in his whole orchard, while he has had them in abundance before. This would indicate that the time to spray for Codlin Moths was about the time the Canker-worms are grown. We suggested the use of a band around the tree to prevent the *wingless females* ascending to lay their eggs. Mr. Partridge writes: "There is a bug nearly as big as a house fly that is crawling on the trees. I

send you two. The little wingless bugs are lively on the south side of the trees though the snow is three or four inches deep among the trees." The insects spoken of above were the wingless females of the Canker-worm.

Remedies.

We would advise a trial of a tin band, which consists essentially of a band or circle of tin a few inches outside of the trunk of the tree, held there by a circle of muslin attached to the tin at its edge and drawn with a cord at the top, so as to fit the tree closely and prevent the insects from getting up without going over the tin. The tin is kept covered with a mixture of equal parts of castor oil and kerosene. As soon as they touch this they fall to the ground. The muslin can be fastened to the tin by turning over the edge of the tin before it is bent to a circle and inserting the edge of the muslin and hammering them together. The tin should be about three inches wide and long enough to stand out three or four inches from the tree, when bent around it and fastened by rivets. The whole inner surface of the tin is daubed with the mixture of castor oil and kerosene. The mixture should be renewed occasionally and the bands kept on the trees until the moths disappear. Fig. 3 shows the nature of the band and the way to attach it. Should the trees be full of eggs or young caterpillars then spraying would have to be resorted to.

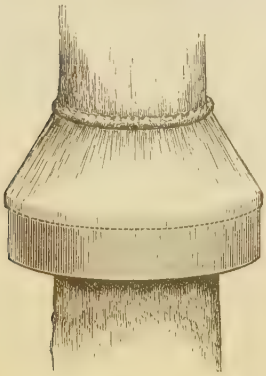


Fig. 3.

Mr. Partridge believes in thorough work and sprayed, using one-half pound Paris green to a barrel of water, consequently the leaves of Tallman Sweets were injured. He speaks of the flower buds of his trees being eaten, apparently before they open. This may have been done by the *Eye-Spotted Bud Moth;* see Sta. Rept. 1888, p. 169, also Rept. 1890, p. 128. The spraying should be done early enough to catch the young worms before they do much damage to the foliage. The time can be determined by watching a few clusters of eggs and when they are hatched the mixture should be applied, or to be safe two sprayings could be made, one just as the leaf buds are bursting and another a week later. While the leaves are young and tender we would advise a weak mixture, say one pound to two hundred gallons. It is a great shock to a tree to loose its

foliage if it is not killed. The leaves are the food formers for the plant. They elaborate the food necessary to make the new wood and perfect the fruit, also it is their office to store, in the new wood and buds, the material necessary to form the leaves the next season. *It is important* to clear the trees of leaf-eating insects as early in the season as possible.

The reader will find an account of the habits of this insect in Expt. Sta. Repts. 1888, p. 166, and 1890, p. 137.

There is an insect closely related to the Fall Canker-worm known as the Spring Canker worm. It differs principally in spending the winter in the ground, emerging very early in the spring and laying its eggs which soon hatch. The Fall Canker-worm changes to the moth state in the fall when the eggs are laid and do not hatch until spring. We have not noticed the Spring Canker-worm to any extent in Maine. We have at present to do with the more abundant one.

The females of both species are wingless, and as both feed on the foliage, spraying would be equally remedial for both. For the spring species bands would have to be applied in the spring. The bands on the trees in the spring would prevent the young caterpillars of both species climbing the trees.

The Boll-worm or Corn-worm.

Heliothis armiger, Hübn.

(Ord. Lepidoptera: Family Noctuidæ).

Last September we received a package of sweet corn from Mr. John M. S. Hunter of Farmington, Me., and the following communication:

Chronicle Office,
Farmington, Me., Sept. 10, 1892.

Sir:—I send you by express to-day a box containing ears of sweet corn. A gentleman in this village planted the corn (sweet corn) in his garden. He tells me every hill is affected and corn in same condition as that which I send you. Will you please look it up and tell the readers of my paper what these worms are and how to exterminate them. This is a great sweet corn region and farmers fear these worms will give them trouble.

John M. S. Hunter, Editor.

About the same time we received specimens of the same insect from Mr. D. H. Knowlton, Farmington, Me., and learned from other sources that it was doing considerable damage to sweet corn in that vicinity.

The ears of corn received, each contained from one to half a dozen worms, snugly concealed beneath the husks at the top of the ears, that were feeding on the kernels. In some of the ears the kernels had been eaten nearly clean on the upper third of the cob. In some of the ears the worms had eaten most of the silk, and in others holes were gnawed through the husks at various places. We at once recognized the worms as the larvæ of the Cotton Boll-worm, an insect that has done untold damage to cotton, corn and various other crops in the West and South. This insect has done more damage in the Southern and Middle States than in the extreme Northern, but judging from the specimens received, it finds congenial conditions in the sweet corn fields of Maine. There is reason for serious concern regarding it, for if it maintains itself and increases, it will jeopardize the corn packing industry.

The damage done is not confined to the kernels eaten. The sap exudes from the kernels gnawed and ferments, so that it would be impossible to use the affected ears for canning. The exuded sap invites a host of smaller insects and fungi to share in the spoils. The husks being left open by the worms eating the silks, allows rains and dew to enter and favor the growth of moulds.

It would not pay to examine carefully each ear to see whether it harbored worms, small insects or fungi before cutting it for canning. Practically a crop much infested by this insect would be worthless for canning, and would have to be utilized so far as possible as food for stock.

If the insect confined its ravages to corn alone it might have a hard time to perpetuate itself on account of the sweet corn being gathered before the worms have their growth. Some of the worms in the corn sent were not more than one-third grown, others were half grown and only a few mature. We put them in a breeding cage and the smaller ones lived until December and died without entering the pupa state, while the larger ones remained gnawing the ears for several weeks before entering the ground.

We are inclined to think the larvæ may in some cases hybernate. The insect is quite a general feeder having been known to do much damage to peas, beans, pumpkins, tomatoes and tobacco, and probably has still other food resources. It should be care-

ully watched for the next two seasons, and if it shows a tendency to increase and spread, concerted action should be taken to exterminate it. That the insect may be known when seen, we give below a condensed description of it in the various stages of its life history and also cuts of the eggs, larva, pupa and moths.

Description.

Eggs—nearly globular, a little flattened at the base, with a slight depression at the top and a series of depressions running from this depression to the base; diameter .025 inches; color pale straw. The moths are said to be capable of laying five hundred eggs which are placed singly upon the leaves by the first brood, and upon the silks and husks at the top of the ear by the later brood. The time required to hatch is supposed to be from two days to a week. Two views of the eggs magnified are shown in Fig. 4, a and b.

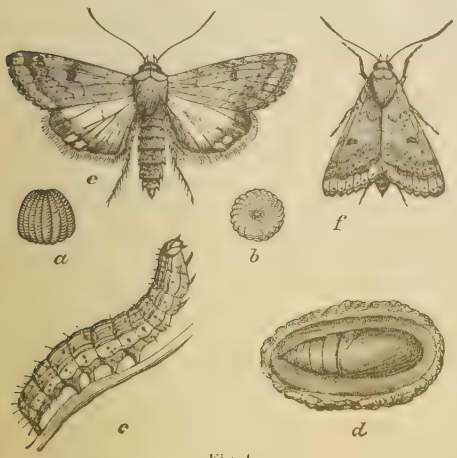


Fig. 4.

Larva—length 1.5 inches when full-grown; color variable, some being pale brown, striped with darker brown, others pale green striped with darker green. There is a dorsal brown band bordered by a narrow light line followed by a darker band that reaches to just above the breathing pores (stigmata) while the stigmata are in a light area that extends to the ventral surface which is of the general body color. On each segment are eight shiny black spots from which arise brown hairs. The four black spots on the back of each segment are arranged in the form of a trapezoid, with the parallel sides transverse with the body, the shortest side toward the head. The two black spots on the sides are just above the stigmata, one above and in front, the other back and on a line with them. Head and legs brown, shield on

the neck (cervex) dark brown. A few short hairs scattered over other parts of the body. See Fig. 4, c. When full grown the worm enters the ground, forms a cocoon of earth interwoven with silk and changes to the chrysalis.

Chrysalis—length .8 of an inch. Color light chestnut brown, the dorsal line, stigmata and divisions of the segments darker. Rather slender, an indentation on the back where the abdominal segments begin, the last four segments moveable, two thorns at the extremity. See Fig. 4, d, which shows the chrysalis in the cocoon.

Moth—expanse of wings 1.5 inches. The color is quite variable in depth of shading. The more common color of the fore wings is pale clay yellow, with a faint greenish tint, and marked with darker olive, dark brown, or even black. A dark, conspicuous spot near the middle of each fore-wing. Hind wings paler with a dark brown band along the outer margin interrupted in the middle by a large pale spot.

The moth with expanded and closed wings is shown in Fig. 4, e and f.

Life History.

In Maine there is probably only one brood of the moths, at least we have no evidence bearing upon the subject to indicate more than one. The moths probably are on the wing early in August. (The larvæ we received on September 10th were of various sizes, some full grown, and though we have not taken the moths in Maine we know the larvæ require three or four weeks to mature, and the eggs several days to hatch which would require that the moth be on the wing early in August). The small worms found in the corn received were from eggs laid on the same ears later, requiring that the moths continue on the wing for some weeks or the time of emerging from the chrysalis extends over considerable time.

The moths mate and the females lay their eggs probably one in a place upon the food plant. They are on the wing early in the evening. The eggs are laid upon the leaves, tassels, silks or husks and hatch in a few days. The worms gnaw through the silk at the top of the ears and feed upon the kernels forming channels at the top of the ears. They will gnaw holes through the silk and go to other ears on the same stalk or even go to new hills. After feeding about three weeks or longer according to the season and

the weather, they are mature and make their way to the ground choosing preferably a spot where the earth is compact, burrow beneath the surface making a round hole which widens toward the bottom and is slightly closed at the top. In this gallery they change to the pupa state. Where there is only one brood they hybernate in the pupa state and appear the following season and the round of life is complete.

Remedies.

Natural.—Bacterial diseases of the worm, moth and eggs are known, besides a half dozen or more insect parasites, Tachinas Ichneumons, prey upon them in the larval state. Lady birds, several species of hyemenopterous insects, tiger and ground beetles prey upon them, and chalcid egg parasites on the eggs. Bats and other insectiverous animals eat the moths. Insectiverous birds and barnyard fowls are fond of them and destroy both worms and moths. Ants and spiders destroy the eggs and young. It is also well known that they will eat each other.

Artificial.—In the extreme North where there is probably but one brood this insect would be more easily checked than where there are two or three broods in a season. Where there are several broods a few survivors of the winter would in the last brood become numerous.

The single brood of Maine could be managed by deep fall ploughing of corn lands to break up the burrows and expose the chrysalides to the effects of fall rain and winter freezing. If a field is found badly infested it would be better to feed the corn green to stock than to allow the worms to mature and enter the ground. Infested ears should never be left in the field so the worms can leave them and crawl into the ground. When possible crush the worms found with the hand.

Any one wishing to look up this insect farther will find a condensed article in the Fourth Report of the United States Entomological Commission, p. 355, which is finely illustrated with colored drawings of the worms and moths.

The Chinch Bug.

Blissus leucopterus, Say.

Ord. Hemiptera: Subord. Heteroptera: Fam. Lygæidæ.

During the past season the following letters were received:

Scarboro, Aug. 23rd, 1892.

Prof. Balentine:

My Dear Sir:—I sent you a small lot of insects from North Fryeburg, on Aug. 8th. I did not know how badly they were destroying the grass, but find they have spread over a large part of the town of Fryeburg, and that the farmers are at complete loss to know what to do to stop their spread. Any advice you can give them would be very thankfully received. I saw Brother B. W. McKeen on Saturday last, and told him what I had done. He was not aware that the damage was so great, as the bugs had not got to his section. Nathaniel Frye, Fryeburg Centre, John Batchelder, or John Hastings, North Fryeburg, would probably give you any information asked for.

Yours respectfully,

W. B. Nutter.

Scarboro, Maine.

Prof. F. L. Harvey,

Orono.

My Dear Sir:—Your very kind letter of the 24th at hand, and contents noted. The bugs you speak of were collected in a field in my own town. They have been found there in years past, and have done considerable damage at times. Can you give me their origin, habits and remedy, if there is any? They work in the grass roots, particularly Timothy hay, which they completely destroy. Thanking you for your information, I am

Yours very truly,

B. Walker McKeen.

We answered Mr. Nutter's letter informing him that the specimens sent were immature forms of the Chinch-bug. We also wrote Mr. McKeen and asked him to secure for us some mature specimens of the insect so as to make its indentification positive, and the following letters were received in answer:

Scarboro, Aug. 29, 1892.

Prof. F. L. Harvey:

My Dear Sir:—Yours of August 26th at hand. In explanation of my sending the bugs to Prof. Balentine, will say I was on a business trip to Fryeburg and seeing the damage the bugs were doing I thought it the quickest way to find out what they were and what to do to destroy them, to send to headquarters. I did not know of anyone except Prof. Balentine to apply to. I have written B. Walker McKeen in regard to the matter and hope you will be invited to make a visit to North Fryeburg and make an investigation. I feel that the matter is quite serious and demands the attention of the State officials to keep it within bounds and to stamp it out if possible.

I have written to Simeon Charles at North Fryeburg to send you some of the bugs in alcohol, and have also written to Nathaniel Frye at Fryeburg Center, asking them both to give you any information they can in regard to the time of the first appearance of the pests, and also how extensive they have become.

Yours truly,

W. B. Nutter.

Scarboro, Maine.

Prof. F. L. Harvey:

My Dear Sir:—Your letter received, and I have sent to Mr. S. C. Charles, North Fryeburg, for further samples. Think he has some of the full grown ones in alcohol. I find some of our Fryeburg farmers claim the bugs have been seen here occasionally for many years, twenty-five or thirty, at least.

B. Walker McKeen.

North Fryeburg, Sept. 6, '92.

Prof. F. L. Harvey:

Dear Sir:—Brother Nutter wrote to me about those bugs that he sent you, saying you thought them to be the chinch-bug. I have got some in a vial which I shall send by this morning's mail. They have worked here for years. Friend Batchelder thinks they were here twenty-five years ago, but did but little damage. They are confined to the intervale wholly—have not been on the upland at all. They have not meddled with anything but herd grass and red top until this fall, when they got on the sweet corn; but have injured it but slightly. Hoping to hear from you and some remedy for the pest, I remain,

Yours truly,

Simeon Charles.

AUGUSTA, Sept. 8th.

PROF. HARVEY:

MY DEAR SIR:—I forward you this letter from Brother Charles. Please acknowledge receipt. Make a *full* investigation. If you plan to go to Fryeburg let us know.

Yours very truly,

B. WALKER MCKEEN.

NORTH FRYEBURG, Sept. 8, '92.

BROTHER MCKEEN:

DEAR SIR:—Received your letter last night. I sent the bugs the 6th. They seem to be going in an easterly direction. I think from what I can learn they are on the Hobbs' intervale. Mrs. Hobbs' boy told me about his grass. No doubt they are at work on it. Hoping to find some remedy,

Yours truly,

SIMEON CHARLES.

We were not able to visit the infested area without leaving class-room work at the college, and it was decided not to do so. Last fall we published a short article in the *Maine Farmer* announcing the occurrence of this insect in the State and suggested burning over the infested fields if possible. It will be desirable this season to learn the extent of the infested district, and we will be pleased to hear from all who may know of its occurrence even in small numbers upon their farms. That the insect may be known when seen, we give below a description of it in all the stages of its life history and suggest such remedies as have been tried in the West and South and have proved at all beneficial.

The information given below has been gleaned from the experiences of Riley, Forbes, Osborn, Gillette and others who have carefully studied the insect and remedies.

Description.

Eggs—Average length .03 in. elongate-oval, the diameter scarcely one-fifth the length. The top squarely docked and bearing four rounded tubercles near the center. Pale whitish and translucent when laid, but becoming amber colored with age, and finally the red parts of the enclosed embryo and the eyes show through. The eggs grow somewhat after being laid. See Fig. 5, a and b, which shows the eggs both natural size and magnified.

Fig. 5.

Chinch-bug, Larva, Pupa and Egg. *a* and *b*, eggs; *c*, young larva; *d*, tarsus of same; *e*, larva after first molt; *f*, larva after second molt; *g*, pupa; *h*, leg; *i*, beak or tubular mouth; *j*, tarsus of mature bug.

Larval stages.—The newly hatched larva (Fig. 5, *c*) is pale yellow, with simply an orange stain on the middle of three larger abdominal joints. The form scarcely differs from that of the mature bug, being but slightly more elongate; but the tarsi have but two joints (Fig. 5, *d*) and the head is relatively broader and more rounded, while the joints of the body are subequal, the prothoracic joint being but slightly longer than any of the rest. The red color soon pervades the whole body, except the first two abdominal joints, which remain yellowish, and the members, which remain pale. After the first molt (Fig. 5, *e*) the red is quite bright vermilion, contrasting strongly with the pale band across the middle of the body, the prothoracic joint [first behind the head] is relatively longer, and the metathoracic joint [third behind the head] shorter. The head and prothorax are dusky and coriaceous and two broad marks on the mesothorax [second joint behind the head], two smaller ones on the metathorax, two on the fourth and fifth abdominal sutures, and one at the tip of the abdomen are generally visible, but sometimes obsolete; the third and fourth joints of the antennæ are dusky, but the legs are still pale. After the second molt [Fig. 5, *f*] the head and thorax are quite dusky and the abdomen duller red, but the pale transverse band is still distinct; the wing-pads become apparent, the members are more dusky, there is a dark red shade on the fourth and fifth abdominal joints, and ventrally a distinct circular, dusky spot covering the last three joints.

Pupa—[Fig. 5, *b*]. In the pupa all the coriaceous parts are brown-black, the wing-pads extend almost across the two pale abdominal joints, which are now more dingy, while the general color of the abdomen is dingy gray; the body above is slightly pubescent, the members are colored as in the mature bug, the three-jointed tarsus is foreshadowed, and the dark, horny spots at the tip of the abdomen, both above and below, are larger.

Perfect Insect (Say's description).—Blackish, hemelytra white with a black spot. Body long, blackish, with numerous hairs; antennæ, rather short, hairs; second joint yellowish, longer than the third, ultimate joint longer than the second, thickest; thorax tinged with cinerous before, with the basal edge piceous; hemelytra (elytra) white, with a blackish oval spot on the lateral middle; rostrum and feet honey-yellow; thighs a little dilated; length less than three-twentieths of an inch.

Fig. 6.

Chinch-bug. The short line below shows natural length.

(Le Baron's description.)—Length 1 2-3 lines, or three-twentieths of an inch. Body black, clothed with a very fine, grayish down not distinctly visible to the naked eye; basal joint of the antennæ honey-yellow, second joint the same, tipped with black, third and fourth joints black; beak brown; wings and wing-cases white; the latter are black at their insertion, and have near the middle two short, irregular black lines, and a conspicuous black marginal spot: legs dark honey-yellow, terminal joint of the feet and the claws black.

Life History.

The *mature bugs* hybernate and may be found during the winter months under grass, dead leaves and rubbish, in the field and about thickets and timber adjoining the infested area. When the weather is warm enough in the spring they emerge from their hiding places and after finding suitable food plants for their young deposit their eggs. This probably occurs in May in Maine, but we have not had opportunity to determine when they begin to move. Each female is said to be capable of laying about five hundred eggs, and oviposition extends over twenty days. After the eggs are laid the bugs live some time and may do damage before they die. The eggs hatch in due time and the young pass

through the larval stages described above and finally pass into the pupa stage. Bugs hatched in May become mature in July when after pairing eggs for a second brood are laid. In July there is usually a flight of the bugs to new fields and by this means the infested area may be greatly extended. The second brood reaches maturity in the fall and by cold weather is ready to seek winter quarters, completing the life history.

Remedies.

It is well known in the West and South where the Chinch-bug has done so much damage, that there are Chich-bug years, when climatic conditions combine to favor the rapid increase of this pest. A wet, backward spring and well distributed summer rains are known to destroy the eggs and young of the first brood and prevent the great increase of the second brood later in the season. The correspondence given above shows, that the pest has been in Maine in the infested district for a great many years, and it has not done serious damage until the past season. The conditions last year were probably a dry time while the eggs and young of the first brood were maturing and they survived in greater numbers than usual and gave rise to a much larger second brood. The coming season may be unfavorable for them and no great injury occur. The heavy rain fall of Maine will probably protect this State from such severe scourges as some of the Western States with less rain fall have suffered. The Chinch-bug seems very much adverse to fresh water baths and does not flourish in moist climates, upon very wet lands, or upon luxuriant crops that shade the ground and keep it moist.

The correspondence shows that the area is increasing and the matter is serious enough to demand careful attention. There should be concerted action upon the part of the farmers of the infested district. Whatever remedy is adopted to check this injurious insect will be of little avail unless it is a combined effect of the entire population in the infested district. One of the great difficulties is to secure concert of action. There are improvident farmers in every neighborhood who harbor weeds and injurious insects and will not destroy them, and there is no law to compel them. Public opinion and moral suasion are the only available levers. Below we suggest some remedial measures that may be applicable in Maine.

a, *Clean Culture.*—As the Chinch-bug hybernates under rubbish, etc., and those that survive the winter determine the number to lay eggs the following season; hence all rubbish and other material about the fields under which they can find shelter should be removed.

b, *Ploughing.*—When a grain field is badly infested it should be ploughed deep immediately after harvest before the bugs can migrate to adjoining crops. The land should be ploughed at least six inches deep and turned as nearly upside-down as possible. By this means a great many young bugs will be destroyed. We do not know whether the bugs have attacked grain fields in western Maine. This remedy would be applicable to a meadow as well as grain field if there was no objection to breaking it up. It is well to harrow and roll the land after ploughing to harden the surface and make it more difficult for the bugs to crawl out. If the bugs are found very numerous along the border of a meadow or in small patches in the field it would be well to plough these places early in the season and in two or three weeks sow to a late crop. Fall plowing is advisable, and if rubbish, straw, manure, etc., are placed on the field the bugs will crawl under it for shelter and be ploughed under. In plowing the use of a jointer is advised as it causes the surface of the ground to be more thoroughly buried.

c, *Burning.*—When the grass or grain stubble is dense enough or dry enough, the entire field should be burned over after harvest. If the bugs are found in a meadow in the fall, that you wish for grass the following season, and the stubble will not burn, then wind-rows of straw or swamp-hay should be put across the field. The bugs will seek shelter under them, when they should be burned early in the morning or late in the evening. The burning should be carried to all other places where they are known to be hybernating.

d, *Miscellaneous Remedies.*—*Early planting* and *heavy sowing* and good *fertilization* have been found important aids in the West to hold this pest in check. The Chinch-bugs only feed upon members of the grass family and rotation of grain with buckwheat clover, peas, beans, or other root crops would starve them out. In the West they sow strips of millet, of which the bugs are very fond, and after they gather upon it it is cut and the ground immediately plowed deep and rolled. Various insecticides have been used with more or less success, but they are omitted as perhaps of no application to checking the insect in Maine.

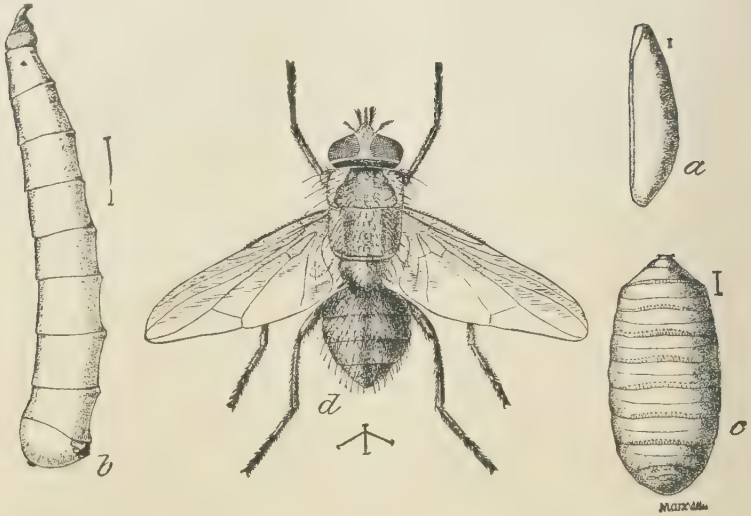


Fig. 1.

Fig. 2.

Fig. 3.

THE HORN FLY.

(Hæmatobia serrata.)

Fig. 1. *a* Egg; *b* Larva; *c* Puparium; *d* Adult in biting position—enlarged. Fig. 2. Adult in resting position—enlarged. Fig. 3. Flies in resting position at the base of the horn—reduced.

The Horn Fly.

(Hæmatobia Serrata, Robineau Desvoidy.)

Ord. Diptera: Fam. Muscidæ.

We received the following letters regarding the occurrence of the Horn Fly in Western Maine:

Augusta, Aug. 27, '92.

Prof. Harvey:

My Dear Sir:—The Buffalo Horn Fly has been very troublesome in Fryeburg and vicinity, so much so that I have used Kerosene Emulsion (Weed formula) on our cows to protect them from their very sharp bites.

Yours very truly,

B. Walker McKeen.

North Fryeburg, Sept. 6, '92.

Prof. Harvey:

Dear Sir:—We are having a visitation of the *Horn Fly*. Can you give us any information in regard to them? They do not appear to bite the cattle very much and do not annoy the horses at all, but they come in immense numbers and over a large territory at once. Yours truly,

Simeon Charles.

Remarks.

This is a European species first noticed in this country in 1887, in the vicinity of Philadelphia. From that point it was spread both to the north and south but more rapidly southward, and now occurs from Canada to the Gulf, west to the prairie states and Texas. The first report of its occurance in Maine was September, 1882, in the vicinity of North Fryeburg, Western Maine. We have not observed it in the Penobscot Valley.

Below we give a condensed account of the life history and such remedies as have been suggested. Those who wish to study the insect more in detail will find it considered in Insect Life, Vol. 4, No. 2, Washington Government Printing Office, 1892, and in U. S. Agrl. Rept., 1889, page 345.

The flies resemble the house-fly in general appearance but are only about half as large. While feeding the wings are spread at an angle of about 60° (see Fig. d) and elevated.

Life History.

The reddish brown oval eggs Fig. a. are laid during the warmer parts of the day, singly and usually upon their sides upon the

surface of the dung immediately after it is voided, the time of oviposition occupying about a minute. The eggs hatch and the larvae (Fig. 1 b.) descend intothe dung, remaining near the surface. When ready to transform the larvæ descend to the ground beneath the dung and enter it from a half to three-quarter of an inch, or if hard probably transform on the surface to the puparium. (Fig. 1 c.) In from ten to seventeen days from the time the eggs are laid the flies appear. (Fig. 1, d.) There are probably seven or eight generations annually in the middle or southern latitudes, but probably a less number in Maine. The fly makes its appearance in May or June and becomes most abundant in July and August, dwindling as cold weather approaches. It probably hybernates in the pupa and adult stages. The flies, when abundant and especially early in the season, collect about the base of the horns of animals to rest, hence the name.

Damages.

The milk of milch cows is reduced in quantity and animals for the shambles rapidly loose flesh. The irritation due to the bites causes the animals to rub themselves, producing sores. The flies bite the animals and suck the blood.

Remedies.

Protective Applications.—Almost any greasy substance wil keep the flies off for several days. Train oil or fish oil alone, or with a little sulphur or carbolic acid will keep the flies off for several days. Tallow has been used to good advantage. Common axle grease will answer nearly as well. These should be applied on the parts of the body most frequented.

Applications to destroy the fly.—A spray of kerosene emulsion directed upon a cow would kill all the flies it happened to touch. Dusting the cows with pyrethrum or some other dust insecticide, as tobacco, is recommended.

Applications of insecticides intended to check the pest by destroying the flies are hopeless against the immense swarms of them.

How to destroy the early stager.—Thoroughly lime the dung or spread it so it will dry. This will destroy large numbers of the larvæ. The most of the dung is dropped in places where the cattle collect after feeding, or at night and could be treated without much trouble.

The Two-Spotted Mite.

(*Tetranychus 2-maculatus, n. sp.*)

Ord. Acarina: Fam. Tetranychidæ.

We first noticed this species in Orono, Me., early in the spring of 1891, upon rose bushes exposed in a window at the Post Office. Since then it has spread to most of the plants in the window excepting geraniums, for which it seems to have an aversion. Mr. White whose rose bushes were infected thought the mites got on while his plant was loaned to a sick lady, but on inquiring we found no other plants were in the sick room at the time and the only possible source of infection was cut plants, which was improbable. In order to learn how general the distribution of this mite was in this region, we visited several houses in Orono, where house plants are kept, and in the majority of places found the mites doing considerable damage. Rejecting the positive statement of one party that these mites are the same as lice on hens and that her plants were all right until she set them out of doors and some lousy fowls infested them, we are inclined to think that the pest was introduced in Maine upon rose bushes and other plants purchased of a prominent dealer. The parties whose plants are infested in most cases had plants from this house and one party positively affirmed that the roses received were noticed to be infested when unpacked. Though great vigilance ought to be exercised by dealers that the plants they send out are in good health and not infested with injurious insects and fungi, yet they cannot always be held responsible, especially when the parasite is small and readily overlooked. Those who receive infested plants will have to discard them, or fight the pest by aid of known remedies.

Even experience has been no protection against the introduction of this mite for it has found its way into the large green houses of the country, also in the green house at the college in our own State and has been a source of much annoyance.

The mite is so small it is next to impossible to examine greenhouse stock or house plants carefully enough to prevent its introduction, and the custom of exchanging slips of plants for culture, so common in every neighborhood, aids greatly in its rapid dissemination.

The mite being firmly established in Orono and no doubt in many other places in the State, and having given so much trouble at

various green-houses in the country and apparently never having been studied, described or figured by any of our entomologists; information regarding its life history, structure and control would seem to be of enough importance to warrant a careful study of the pest.

Having spent some time during the past two years investigating the nature of this species, the following preliminary notes upon it are humbly submitted, with the hope that they may aid in recognizing the form and put our florists upon their guard against it. We cannot hope to have been infallable in our observations, but have tried faithfully to record what we have seen.

We desire to acknowledge our indebtedness to Prof. L. H. Bailey of Ithaca, N. Y. for specimens of this mite, and also of the red spider for comparison, for a list of host plants and other data from his experience with it; to the Dingee & Conard Co., West Grove, Pa., for specimens of red spider and notes; to Peter Henderson & Co. for specimens of the mite on *Verbena* and notes; to Prof. Munson and citizens of Orono who from their abundance have supplied us without reluctance with all the specimens used for study.

Correspondence.

After discovering this mite at Orono, Prof. Munson suggested that it was probably the same species that had given so much trouble in the green-houses at Ithaca, N. Y. We wrote Prof. Bailey and sent him a description of the mite. He responded: "Your description seems to match the mighty mite which we have. I do not know its name. Prof. Comstock does not know it." We wrote again for specimens for comparison and a list of food plants and in our letter called the species *Tetranychus 2-maculatus*, n. sp., as we had not been able to find any published description of it. Prof. Bailey responded with specimens upon Pepino, which proved to be the species found at Orono, also he stated: "This is the 'Verbena mite,' I suppose, of Henderson's Practical Floriculture." We responded to Prof. Bailey that the specimens sent were the same as the species found here, but whether they were the same as the *Verbena mite* referred to in Henderson's Practical Floriculture could not be determined by the vague description given in that work, which though it might serve the purposes of practical horticulture, was valueless from an entomologist's standpoint.

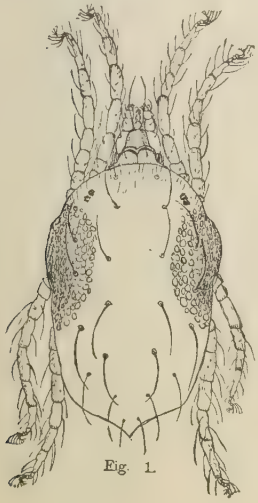


Fig. 1.

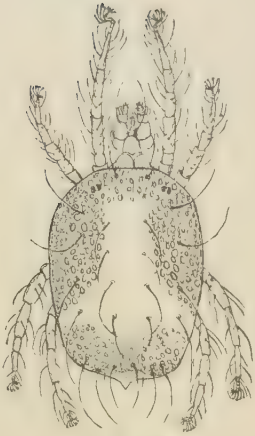


Fig 2.

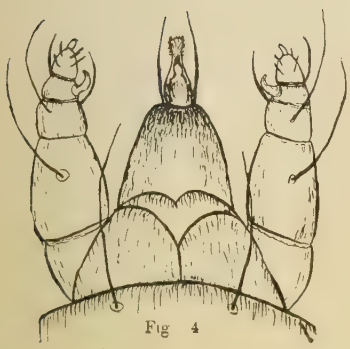


Fig 4

Fig 3.

F. L. HARVEY, Del.

TWO SPOTTED MITE.

(Tetranychus 2-maculatus, n. sp.)

Fig. 1. Male mite magnified 100 times. Fig. 2, Female (probably) magnified 100 times. Fig. 3. Foot much magnified *(a)* showing location of moveable joint. Fig. 4. Mouth parts and palpi magnified about 250 times.

If you have seen what Henderson calls the "*Verbena mite*" and know it to be the same species as you sent me, that certainly is a clincher. Henderson's figure certainly is nothing like the mite in question. His figure is pointed in front while the mite we are considering is broadly oblong and rounded in front. Henderson's figure is 20 m m. (.8 in.) in length and he says it is magnified four hundred times. This would make the mite only .05 m m. (.002 in.), a *very minute microscopic form*. The mite we are considering is fully .5 m m. or .02 in. and *plainly* visible to the naked eye. Perhaps Henderson made a mistake and his drawing was only forty times magnified. We could believe this if he did not state that the *Verbena mite* "is so small that it cannot be seen by the naked eye." Henderson says it has the power of imbedding itself in the leaf, a habit which *certainly* does not apply to the species in question. Certainly Henderson has made a good many mistakes in his description or the species he examined was a different species. We believe it is best for entomologists to entirely ignore such loose, vague descriptions of insects as they are of no technical importance and only add confusion in defining species.

In the absence of any known technical description of this species, we concluded it would be better to describe it under the name *Tetranychus 2-maculatus*, n. sp., and have something *definite* than to leave the form without a name. Should it subsequently be shown that it has been described then our name drops and no harm is done. We will be most grateful for any evidence that this species has been described or named for we have no ambition to multiply synonyms.

Prof. Bailey responded: "I am aware that neither Henderson's description nor figures are applicable to the mite in question, and yet I think that he meant it, for I have known for some time that he has been troubled with the same species we have. Of course the reference, even if proved to apply to the mite, is of no scientific use, and I only referred you to it that you might perhaps gain a wider knowledge of its hosts and distribution. No doubt Alfred Henderson could send you specimens for determination."

Prof. Bailey kindly introduced us to Mr. Henderson and we requested specimens of the *Verbena mite* which proved to be the *same* species found at Ithaca and Orono.

Parties about Orono having stated *positively* that roses obtained from Dingee & Conard Co., West Grove, Pa., were infested by this mite, and we having seen the mite on rose bushes from that firm at one house and not on *any other* plants, and the mite having

been first noticed at the Post Office in Orono on roses, we wrote Dingee & Conard Co. about the matter and below we give their reply.

West Grove, Pa., Jan. 21, '92.

Francis L. Harvey, Esq.,
Orono, Me.

Dear Sir:—Your kind letter to hand and contents carefully noted. We will gladly give you any information we can to assist you in this important undertaking. The insect or pest you describe which is so seriously affecting window and house plants through your locality, we must say we know nothing of. We have not come in contact with such a pest in any of our houses or on our plants like this, and can assure you it did not originate with us, or we would know something of it. Such pests are more frequently found among soft wooded plants. We have but little of this class of stock in our establishment and consequently are troubled but little with any insect. We are sometimes visited with the *red spider* on our roses, but such is a very rare occurrence, and when thus affected it is not at all a serious matter to get rid of them, syringing them twice a day being a very satisfactory remedy and always effective. We find when plants are kept in a perfectly healthy condition there is little or no danger of the pest or insect of any kind attacking them. The *red spider* can hardly be termed a pest. It is with us but a mild disease caused by too warm and dry an atmosphere. We shall be glad if this information is of any advantage to you and will gladly give you any other information we can.

Very truly yours,
The Dingee & Conard Co.

We wrote again to Dingee & Conard Co. for specimens of what they regarded as the *red spider*, and the species sent was the same as the one found here so far as we could tell from a careful microscopic examination. We also requested Prof. Bailey to send us specimens of the *red spider*. He said they had none in their houses but one of his men procurred some from another source which we were unable to separate from the Cornell green-house specimens only by their being redder in color.

We must confess that we are very much confused by the above data. Henderson, Bailey and Munson, who have had considerable experience with this mite are decided in their opinion that it is entirely different in its habits from the *red spider* and will not

yield to the same treatment. If the specimens sent us by Dingee & Conard Co. and Prof. Bailey's men, were the genuine *red spider*, we are forced to conclude that in this mite we have a species scarcely separable from the *red spider* by its structure but differing very much from it in habit. If called upon to decide from the structure alone we would be compelled to call it a form of the polymorphous species *Tetranychus telarius*, L., or *red spider*.

No importance can be attached to color in this species nor in the *red spider* for in both it is variable with the food plant and also with the age, each molt disclosing a different shade. All we have left upon which to construct this species is the marked physiological differences, noted by Henderson, Bailey and Munson. Can it be possible that it is a case of adaptability—a form of the *red spider* that has changed its mode of living to suit new conditions? Such cases are not uncommon among insects. We leave it an open question for a want of sufficient data. The published descriptions and figures of the *red spider* are so meagre and so lacking in minute detail that it would be very difficult to determine from them whether specimens in hand belonged to that species. Even the published characters of the genus Tetranychus are faulty on account of imperfect microscopical examination.

General Description.

Perfect insect—length of full grown specimens, including palpus, .4 to .6 m m.; breadth, .25 to .3 m m.; thickness .175 to .2 m m. Broadly oval, about two thirds as broad as long. Broadest in the anterior third of the body back of the eyes, where the sides are somewhat swollen. General color when young or free from food, pale orange or greenish yellow, becoming yellowish orange or orange with age. The *majority* of the specimens have a dark spot on each side as shown in Fig 1. due to food contents. These spots first appear, in young specimens which have six legs, as scattered brownish or greenish spherical bodies that look like oil drops. These increase in number with age and are sometimes arranged in three groups. Finally they merge into a single mass as shown in Fig. 1. In older specimens dark patches are found in the anterior and posterior portions of the body, (see Fig. 2), or in full fed specimens the body is entirely dark colored. The shade seems to vary with the color of the food, from the yellow orange and brown to green, dark green or black; those feeding on calla, especially, a deep dark green.

The palpi and legs, especially in older specimens, are tinged with orange. The young are smaller, paler and have only six legs. Body and legs clothed with stout bowed hairs. There are four rows of about five hairs each on the dorsal aspect of the body. Eyes carmine, composed of two facets placed one ahead of the other, and obscurely bilobed. Palpi about one-fourth the length of the body. Eggs spherical, diameter variable, length 75 to about 110 micromillimetres, glassy, scattered and loosely attached to the web. Web delicate, filmy, stretched loosely over the surface of the plant, principally on the under surface of the leaves, though sometimes the upper surface is covered, often stretching across from leaf to leaf, or from the stem to the petioles. They are more plentiful along the principal veins, especially where they join the petiole, also in the angle where the petioles join the leaf, being plainly visible to the naked eye and giving a glassy or silvery reflection from the surface covered. Fibers of the web are from 10 to 20 micromillimetres in diameter but apparently composed of smaller fibrils. The web does not seem to be geometrically constructed as that of the spider. The mites walk freely over the surface or secrete themselves beneath it. The feet are long and the movement of the mite slow and spider-like.

Microscopic Characters.

The body, legs and mouth parts magnified five hundred diameters appear finely corrugated, the ridges and furrows often less than .001 m m. wide. On the under side of the body toward the posterior end is an elevation in which the corrugations are much wider and zig-zag. This probably marks the location of the spinerets and anal opening. The stout hairs clothing the body are in full grown specimens often one-fourth the length of the body, or about .15 m m. The eye facets are about .05 m m. in diameter. The hairs on the legs are about four times as long as the legs are wide where they occur, or sometimes fully .1 m m. long. The legs are composed of seven joints exclusive of the moveable foot portion. The seventh joint is short, a little longer than the three segments of the foot combined and has but little movement with the sixth joint. The foot portion is composed of three joints, the proximal two about equal in size, same length but wider than long; terminal segment curved and ending in a two claws; each fork ending in a brush of about three stiff, pointed, spreading hairs. At the back on the end of the preceeding segment arise four stiff bowed hairs over .02 m m. long ending in hemispherical

swellings which are broadest at the end and flat or slightly rounded. These hairs curve in the same direction as the claw and extend considerable distance beyond it. There is a free joint between the seventh segment of the leg and the foot portion. The two joints and the claw make up the moveable parts. When walking on glass or any smooth surface the mite puts the paw out behind as one would bend the hand backward at the wrist, resting on the end of the seventh joint, the claw and the end of the four stiff hairs, the terminations of which are put squarely down upon the surface. These hairs with enlarged ends may be used for spinning as suggested by Murray, but one cannot watch the movements of this mite without believing they are adapted for locomotion.

According to Murray, the stiff hairs on the feet of *Tetranychus telareus* (the *red spider*) are attached to the claws, and he has so represented them in a cut (Economic Entomology, p. 97). In this species they are appendages of the small joint of the foot next to the claws. Also he says these hairs have globular terminations and so figures them. In our specimens the hairs end in trumpet-mouth like terminations, disc-like at the ends and are put flat on the surface in locomotion. Prof. Riley in *T. 6—maculatus*, (U. S. Agrl. Report, 1889, p. 111), represents the hairs as originating from the back of the claws and as hooked at the ends. The mouth-parts of the *red spider* as shown by Murray, and those of *T. 6 maculatus*, Riley, differ from those of our species.

According to the characters laid down for the genus *Tetranychus* by Murray, there should be only seven joints in the legs. We are at a loss to know just what was included by him in the terminal or tarsal joint. There are seven segments in the leg above the moveable joint in the foot region spoken of above. If the three moveable elements below this joint constitute a distinct segment, then there are *eight* joints to the leg. If the fixed short segment above the moveable joint is concluded in the terminal segment, then there are only *seven* joints to the leg. The location of the joint is shown in Fig. 3, a. Extending from the front of the carapace are the mouth parts, made up of the palpi, rostrum or beak, proboscis and mandibles. The *palpi* (see Fig. 4) are seven jointed. The terminal joint is short, about .008 m. m., with parallel sides and an obtuse rounded end, twice as long as broad. Second joint is broadly conical, somewhat broader at the base than long, length about .015 m. m. at top and .025 m. m. at base, bearing on

the inner face about four bristles, see Fig. 4. The third joint is not more than half as long as broad (about .015 m. m. by .03 m. m.) bearing on the inner side a claw about .02 m. m. long, curved toward the face of joint two, which bears the bristles. There is a free motion between segments two and three, and joints one and two are moveable and opposed to the claw on joint three, making nipping jaws. The structure of the end of the palpus of this species has a striking resemblance to that of *T. 6—maculatus*, Riley figured in U. S. Agrl. Report, 1889, pl. II., though the third short joint bearing a claw seems to be absent, or not shown in his drawing. The *rostrum* or *beak* is composed of three segments, (see Fig. 4) the basal one composed of two parts, broad at the base and rounded in front, and at the carapace reaching beyond and covering the base of the palpi. The second joint is short and emarginate in front, terminal segment tongue shaped, obtuse and emarginate in front. Originating beneath the rostrum and extending forward beneath the palpi are two stout hairs. The basal portion of the proboscis is covered by the beak of the carapace. The visible portion is composed of three joints. The basal is broadest and oblong; the terminal one slender, rounded in front and bearing at the edge two short spines and near the end numerous slender spines. The details of the mandibles we could not make out clearly but think they are rounded and plain on the outer margin, bearing at the end a lobe which projects beyond the end of the proboscis.

Greenish black spots are usually found on the leaves of plants affected by this mite. Probably this is the reason why Henderson called the disease by the inappropriate name "Black Rust." It is commonly believed that these dark spots are formed from juices of the plants that have exuded from punctures made by the mites and have dried. A careful microscopic examination proved them to be small usually globular masses from .1 m m. to .175 m m in diameter and composed of spherical elements from .025 to .035 m m. in diameter. These spherules are clear with granular contents, or greenish with a darker centre. A careful comparison of them with the contents of the body of the mites proved that they were excreta. These yellowish, or black balls are often found attached to the fibres of the web in *mid air* between the points of attachment of the web where it stretches across from leaf to leaf or from stem to leaf. This could not possibly occur if they were exudations from punctures. The web running over the surface and dotted here and there with these yellow and black excreta reminds one of a minute erysiphe in different stages of development.

Host Plants.

From the table of host plants given below, it will be seen that this mite is a general feeder, attacking a wide range of both glabrous and hirsute plants belonging to a wide range of families. This list is no doubt far from complete, as no great pains has been taken to make it exhaustive. Should this mite prove capable of living out of doors it would become a double terror to horticulturists. It at present is found out of doors only in rare instances, and there is no evidence that it is as Henderson suggests, common in gardens, or the same as that which produces roughness to particular parts of cherry, plum and peach trees. Our experience does not warrant the belief that it attacks *especially* plants of lessened vitality. These mites, like plant lice, live by sucking the juice of plants, and are pretty good judges of proper feeding grounds. They are not likely to turn aside from a healthy juicy plant to one of the same species that is sickly and lacking in juices. They are small and would escape observation until a sickly condition was produced in the host plant and attention directed to it. We believe that instead of especially attacking sickly plants they are the cause of lessened vitality. The list of host plants given below shows that the mite has no special preference for pubescent plants, in fact, some of the worst cases of attack we have seen were upon glabrous species. Munson and Harvey are authority for the occurrence of the mite at the Maine State College green-houses and at private houses in Orono and vicinity; Prof. L. H. Bailey for the occurrence of the mite in the green-houses at Cornell College, Ithaca, N. Y.; Henderson for its occurrence in their green-houses, New York City; Dingee & Conard Co. for its occurrence at West Grove, Pa.

Host Plants.

Order.	Common Name.	Technical Name.	Authority.	Remarks.
Ranunculaceæ.	Jackman's Clematis.	Clematis Jackmanni.	Munson, Harvey.	College green-houses only.
Resedaceæ.	Mignonette.	Reseda odorata.	Munson.	" " " "
Caryophyllaceæ.	Pink.	Dianthus caryophyllus.	Munson.	" " " "
Malvaceæ.		Malope grandiflora.	Bailey.	
"	Indian Mallow.	Abutilon species.	Bailey.	
Geraniaceæ.	Stork's Bill.	Pelargonium species.	Henderson.	Plants of this family have not been attacked at the College nor in Orono.
"	Canary Bird.	Tropæolium peregrinum.	Munson.	
Leguminosæ.	Beans.		Bailey, Munson, Harvey.	At Orono beans out of doors badly affected.
Rosaceæ.	Ordinary Roses.		Harvey, Durgee & Conard Co.	
"	Polyantha roses.		Bailey.	
"	Apricot.		Bailey.	Growing out of doors, near green-house.
Lythraceæ.	Cuphea.	Cuphea Llavæ.	Henderson.	
Onagraceæ.	Godelia.	Œnothera species.	Bailey.	
"	Ladies' Eardrop.	Fuchsia species.	Harvey.	Plants in Orono badly infested.
Passifloraceæ.	Gronadella.	Passiflora edulus.	Bailey.	
Cucurbitaceæ.	Cucumbers.	Cucumis sativus.	Munson, Bailey, Harvey.	
"	Musk Melon.	" Melo.	Munson.	College grounds.
Rubiaceæ.		Manettia species.	Henderson.	
"		Bouvardia species.	Henderson.	
Compositæ.	Feverfew.	Leucanthemum / Parthenium.	Harvey.	Plants in Orono.
"		Chrysanthemum	Harvey, Henderson.	
Scrophulariaceæ.	Monkey-flower.	Mimulus tigricoides.	Munson.	
"	Musk Plant.	Mimulus Moschatus.	Munson.	
"	Slipper Flower.	Calceolaria species.	Henderson.	
Acanthaceæ.	Thumbergia.	Thumbergia alata.	Bailey.	
Verbenaceæ.	Verbena.	Verbena species	Henderson, Bailey, Harvey.	
		Lantana species.	Henderson.	
Labiatæ.	Sage.	Salvia splendens.	Munson.	
Borraginaceæ.	Heliotrope.	Heliotropum sp.	Henderson.	
Convolvulaceæ.	Cypress-vine.	Quamoclet vulgaris.	Munson.	
"	Moon-flower.	Ipomea noctophylon.	Munson.	
"	Morning Glory.	Pharbitis species.	Bailey.	
Solonaceæ.	Tomato.	Lycopersicum esculentum.	Munson, Bailey, Harvey,	
"	Pepino.	Solanum muricatum.	Bailey, Munson.	
"	Egg Plant.	Solanum melongena.	Bailey, Munson.	
"	Pepper.	Capsicum annuum.	Munson.	
"		Petunia species.	Harvey, Henderson.	
"	Wedding Bell.	Brugmansia arborea.	Harvey.	Very badly infested.
Euphorbiaceæ.	Castor Oil Plant.	Ricinus communis.	Harvey.	Badly infested.
	Hop.	Humulus lupulus.	Munson.	Out of doors.
Araceæ.	Calla.	Calla species.	Harvey.	
Smilaceæ.	Boston Smilax.	Myrsiphyllum asparagoides.	Bailey.	Very bad.
Liliaceæ.	Easter Lily.	Lilium Harrisii.	Harvey.	

Remedies.

The experience of Bailey, Henderson and Munson would lead one to conclude that there is no remedy at present known that is entirely effective.

Henderson writes us that one of the best remedies is Fir Tree Oil, and another very good one is Cole's Insect Destroyer but the cost of the latter almost prohibits its being used in large quantities. Prof. Bailey has had considerable experience with Fir Tree Oil but does not find it entirely satisfactory, though of considerable value.

Prof. Munson says he has used an alcoholic tincture of Pyrethrum and finds it quite satisfactory. There is a general belief that the red spider is readily destroyed by a copious use of water and will not flourish in a moist atmosphere. The impression of those who have had most experience with this mite, is that it may be very bad in a moist atmosphere. Prof. Munson relates one instance of a cucumber house where the plants were badly infested though the atmosphere was kept quite moist. We believe, however, that spraying the plants frequently with water, would help hold them in check by reducing the temperature. They seem to enjoy a high temperature.

Henderson believes an ounce of preventive is better than a pound of cure and if the plants are kept in good health they will resist the disease. He has frequently noticed that where plants become pot-bound it would make its appearance while others potted at the same time and shifted as the occasion required would be perfectly free from it, thus showing that the disease is altogether the result of imperfect conditions of growth. We have commented upon this elsewhere under the head of host plants.

Fir Tree Oil can be obtained from August Rölker & Sons, 136 W. 24th St., N. Y., at a cost of $3.25 per gallon, in five gallon lots, less ten per cent. for cash with order. It should be diluted about one hundred times with water and applied with a syringe or atomizer.

Alcoholic Tincture of Pyrethrum—Digest one part by weight of Pyrethrum (Dalmation Insect Powder) in four parts of commercial alcohol and apply the undiluted tincture to the foliage with an atomizer.

Cole's Insect Destroyer—Mr. Henderson says: "Is sold in half pint cans, price 50 cents. It is already for applying with an atomizer, such as is used for perfumery. Being very powerful a little is sufficient. For house plants we know of no better insecticide."

Cut Worms.

We publish the following correspondence not to criticise Mr. Fowler but to call attention to the loose way in which names are applied to insects and the importance of being certain about the names of insects doing injury before applying remedial measures. We were glad to receive Mr. Fowler's letter for it offered us the opportunity of explaining the restricted use of the term cut-worm by entomologists and that it is not used in the brood sense that includes any kind of worm found feeding upon the roots of farm crops. We will always be pleased to answer questions or explain differences of opinion.

Correspondence.

Searsmont, Me., Sept. 9, '92.

Mr. F. L. Harvey:

Dear Sir:—Part V of Ag. Rept. is at hand and in reading about cut-worms I think my experience may help some one. Cut-worms used to trouble my beets and corn. I noticed when green manure was used in the spring and left uncovered for any length of time—say half a day—a yellow fly such as one sees around manure piles used to fly around and on the manure in the drills, and produce an abundant crop of dark gray or brown or nearly black cut-worms. When manure was hauled from *dark* barn cellar and *immediately covered* found no cut-worms. So by keeping

manure in cellar until wanted for use and keeping cellar dark so no flies would stay there and covering manure immediately I am clear of the pest. Whoever uses barn-yard manure, or manure that is stacked will find plenty of them. For proof examine droppings of cattle in pasture and around buildings and enough of these pests will be found at some stage in the manure. Hoping this may help some as a suggestion I send it.

Very truly,

Moses A. Fowler.

The following is our answer somewhat changed and extended for publication:

Orono, Me., Sept. 23, '92.

Mr. Moses A. Fowler:

Dear Sir:—You and I have different ideas about cut-worms. According to my understanding the term cut-worm is *restricted* by entomologists to the larval or caterpillar stage of Hawk Moths such as I have figured in my Report, Figs. 4, 6 and 7 and is not used in the broad sense suggested by you, which would include all worms that eat or cut the roots or other parts of farm crops.

The yellow insects to which you refer belong to the *Order Dieptera* or *two-winged flies*, related to the house-fly and in their worm stage should be called *maggots*. Our root crops are often affected by maggots, as the maggot of the Radish Fly and that of the Onion Fly, but these do not cut off the plants like cut-worms but bore into the roots. The moths of cut-worms lay their eggs near the roots on grass in meadows and pastures and *not* in manure piles. The white *grubs* found in manure are the larvæ or worm stage of beetles (Coleoptera) like the May Beetle and related species. Though the housing of manure is to be recommended to prevent leaching and no doubt if properly protected would be less infested with manure loving larvæ, but cut-worms do not seek such a nidus for their eggs.

Your crops were probably affected by the maggot of some fly, or more probably the grub of some beetle, or possibly by genuine cut-worms that had crawled from adjoining meadow or pasture lands. It may have been the grub of the *Three-toothed Aphonus*

mentioned in my Report, 1891, p. 199, as cutting corn. The sources of insect pests are so many, and the species that feed upon our farm crops so numerous, it is important that each case of injury be carefully examined.

If you will send me in a small box the worms you call cut-worms I will take pleasure in examining them and tell you whether they are correctly named.

Very truly yours,

F. L. Harvey,

Entomologist for Station.

Report of Botanist and Entomologist.

Prof. F. L. Harvey.

Professor W. H. Jordan:

Dear Sir—I have the honor to submit herewith my sixth annual report as Botanist and Entomologist for the Experiment Station. The demand for information about injurious fungi, weeds, forage plants and injurious insects is increasing. More letters of inquiry were received the past season than ever before. Many of these letters were about insects and fungi already considered and figured in previous reports and from parties who must have had access to the Station Reports. It is apparently less trouble to send specimens to the Station for examination and positive determination than to look them up in the reports. Extensive and carefully detailed correspondence must form an important feature of Station work. Such letters are usually answered by referring to the published accounts in the Station Reports. Specimens when new to the State are reported upon in detail, and if of sufficient interest are considered and figured in the annual report. Below will be found tabulated and considered the most important plants and insects that have been studied the past season The season has not been marked by the extreme ravages of any insect, or the widespread prevalence of any species of fungus, though some of those that gave trouble last season have increased and a few have been added to the list of our State pests.

Pear-Leaf Blight seems to be spreading in the western part of the State in the vicinity of Portland. Any whose pears crack open in ripening will do well to read the article on this disease in Experiment Station Report, 1892, page 109. The Bean Anthracnose, a disease that causes brownish spots upon snap beans, (especially the white-podded varieties), was quite prevalent the past season. Tomato Anthracnose, a fungus attacking ripening and ripe tomatoes was abundant in the Station garden and elsewhere in the State. The Beet Scab, a disease causing warty excrescences upon beet roots, and said to be produced by the same fungus as Potato Scab was abundant in the Station garden and other places in the State. The Clover Rust was unusually bad (especially on second-growth clover,) about Orono. A new tomato disease causing depressed dark

Report ... the Maine Agricultural Experiment Station:
Part ... No. 8.

patches upon ripened tomatoes did considerable damage to the Station tomato crop. The STRAWBERRY SEPTORIA was very abundant upon Station strawberries. The ORANGE HAWK-WEED still spreads. As it seeds before harvest, spreads by runners at the roots and is perennial it will yield to nothing but the spade and hoe, and the earlier attended to the less trouble. The ARISTATE PLANTAIN, a near relative of the ENGLISH PLANTAIN has made its appearance in the State. In response to an enquiry regarding wild rice we have learned that it is plentiful in the State.

THE FALL CANKER WORM is gradually spreading. Besides apparently holding its own in known localities several new localities have been reported the past season. This species is sometimes accompanied by the LIME-TREE WINTER-MOTH an insect similar in its habits but checked by spraying like the CANKER-WORM.

THE ANGOUMOIS GRAIN MOTH was found in great numbers in boxes of *Shaker Pop Corn* offered for sale in Orono. This is one of the worst grain insects. The grain exhibits at the World's Fair were badly infested with it. It is capable of doing much damage to stored grain and its spread in the State would be a misfortune.

THE STALK BORER, (*Gortyna nitela*, Guen.,) and THE BLACK CANTHARIS, (*Cantharis atrata*,) were both reported as doing damage to potatoes; the former boring into the stalks, the latter in great numbers feeding upon the foliage.

THE RED-HUMPED APPLE TREE CATERPILLAR seems to be increasing in the State. It was reported from a new locality this season and we found it also in the Station orchard, probably introduced on nursery stock.

THE APPLE-LEAF BUCCULATRIX, (*B. pomifoliella*, Clemens.) A small moth, the larva of which skeletonizes the leaves of apple trees was reported as doing considerable damage. This insect has not been noticed before.

Specimens of pears received from F. Frank Jones, Portland, bore the characteristic cuts of the PLUM CURCULIO. Some of the fruits had five incisions and were badly dwarfed and distorted.

THE STRIPED SQUASH BEETLE, a very common garden pest seems to have been unusually abundant the past season. Thick planting and then thinning, as the plants get older; protecting the seedlings by boxes or half hoops and netting, or even hand picking the beetles will usually insure a good stand of cucurbitaceous plants.

Mr. C. A. Wood of Searsport sent us a species of Rove Beetle, *Ancyrophorus planus*, and The Four-spotted Pityophagus, *P. 4-guttatus*. Both were accused of destroying the kernels of sweet corn at the top of the ear. Ears of damaged corn accompanied the accused. We were able to acquit the above beetles as the corn showed the unmistakable work of the Corn Worm which was considered in our last report on P. 119. The true culprits, full fed, had probably crawled away to transform. The above insects were in the corn to feed upon the sugary and starchy matter that flowed from the broken kernels.

The White Grub or larva of the May Beetle, *Lachnosterna fusca*, has been doing much damage to grass lands in the vicinity of Bridgton. As there is no certain remedy known for this insect it would be advisable to do some field work upon it and try the most hopeful remedies suggested by entomologists and prove their value or worthlessness.

The Pear Blight Beetle working in the limbs of apple trees and boring the wood full of small channels is a new injurious insect to the State.

We receeivd specimens from two widely separated localities so it must be widespread. Its presence can be detected by small shot-like holes in the bark. It attacks healthy trees and there is no remedy but to cut the branches infested and burn them.

The Bean Weevil spoken of in our last report is considered and illustrated in this. The Horn Fly was quite abundant in some localities. It is migrating eastward and was quite abundant at Hudson and other localities in the Penobscot valley this season.

The Carrot Fly, *Psila rosæ*, was received from Mr. C. H. Morrell, Pittsfield. It was found infesting stored carrots. This is a European insect never before detected in the United States. The carrots were literally alive with maggots.

Beets in this region were badly infested by a species of *Anthomyia* or Beet Fly, the larvæ of which eat the pulp from the leaves, leaving the epidermis. The eaten spots are clear whitish and in them the maggots can often be seen between the epidermi.

The Currant Plant Louse, *Aphis ribes*, L. has been doing damage to gooseberries in Aroostook and Piscataquis counties the past season, destroying the foliage and causing a second growth of small leaves.

The Apple Maggot, *Trypeta Pomonella*, Walsh. still is doing much damage in Maine as well as in adjoining states, if we can judge from the demand for our article on this insect, published in the Station Report for 1889. We received a long newspaper article from a New Hampshire correspondent, which he had written to give the fruit growers of his state the life history of this pest. The article was accompanied by specimens in the "*long-winged*" stage of their development, graphically described by the writer. The specimens were a species of Ichneumon which does not even belong to the same order as Trypeta, which is a *two winged* fly. The article was full of other errors. We notice this merely to warn farmers and fruit growers against articles upon technical subjects by non-professionals. To trace the life history of an insect requires great care, and a knowledge of insect forms that can not possibly be obtained except by long experience.

In the above mentioned article at least *three insects* belonging to *different orders* were regarded as *stages* in the life history of *Trypeta* and *none of them pertained to that insect* The best way is to send injurious insects to the professional entomologist. *Absolute* identification of a pest is the first thing necessary in coping with it.

The Chinch Bug still continues to do damage to meadow lands in the vicinity of Fryeburg. It will be well to do some field work in that region another season to learn the extent of the infested district and gain any information that will enable us to suggest remedial measures.

Tetranychus 2-maculatus, Harvey, was reported from Piscataquis county the past season. While we were in Chicago, during July, specimens of this mite were submitted to us for examination. They came from a greenhouse near Chicago, showing this pest is widely distributed.

DIRECTIONS FOR SENDING SPECIMENS.

Regardless of the careful directions given in previous reports for sending insects, several specimens were received the past season, in envelopes or fragile paper boxes and when they arrived were crushed almost beyond recognition. Other packages came without the name and address of the sender upon them. Insects should *always* be sent in wooden or tin boxes and some of the food plant or injured material enclosed. Notes upon the habits of the insect

should accompany the specimens, and the sender's name and address should be upon the package even if a separate letter is written. We sometimes receive several packages the same day and if not plainly marked we are unable to tell from whom they come.

Directions for sending specimens will be found in the Annual Report of the Experiment Station, 1888, p 194, or in Maine Agricultural Report, 1888, p. 158. Correspondence regarding injurious insects and fungi is invited. Insects and plants will be named, and when injurious, remedies suggested. It is to the interest of farmers to detect injurious insects and fungi before they become established, so that remedial measures can be adopted before the pests are beyond control. As the Entomologist's duties prevent him from going much about the State, it is largely through correspondence that the Station learns of insects doing injury in the State.

REMARKS.

The cuts and plates to illustrate this Report were obtained from the following sources: From the Department of Agriculture, Washington, D. C.; the plate of Plantago Patigonica, cuts of the Angoumois Grain Moth, and cuts of the May Beetle; from J. B. Lippincott & Co.; cuts of the Lime-tree Winter-moth, the Apple-leaf Bucculatrix, the Disippus Butterfly and the Pear-blight Beetle; from Prof. A. E. Popenoe, cuts of the Bean and Pea Weevils; cuts of the bean Anthracnose and Carrot Fly are from original drawings made by the writer.

PLANTS REPORTED AND EXAMINED—1893.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Hair Mold	*Phycomyces nitens*	Chas. P. Kitridge, Milo	On excrement. See Experiment Station Report, 1892, p. 111.
2	Pear-leaf Blight	*Entomosporium maculatum*, Lev.	T. Frank Jones, Portland	Attacking the leaves and fruit of pear trees. See Experiment Station report, 1892, p. 109.
3	Bean Anthracnose	*Colletotrichum Lindemuthianum*, (S and M) (B and Cav.)	Eugene T. Perkins, Kennebunkport; Prof. W. H. Jordan, Orono	Causing brown spots on the pods of beans.
4	Anthracnose of the Tomato	*Colletotrichum phomoides*, Sacc.	F. L. Harvey, Orono	Causing ripe rot on tomatoes.
5	Beet and Potato Scab	*Oospora scabies*, Thaxter	F. L. Harvey, Orono	Causing warty excrescences on beet roots and scab on potatoes.
6	Orange Hawkweed	*Hieracium aurantiacum*, L.	E. W. Dutton, New Sharon	Coming uninvited into fields.
7	Aristate Plantain	*Plantago Patagonica* var. *aristata*, Gray	Mrs. A. M. Pikes, East Madison	In oat field.

INSECTS REPORTED AND EXAMINED—1893.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Fall Canker Worm	*Anisopteryx pometaria*, Harris	B. Walker McKeen, Augusta, Chas. S. Pope, Manchester, W. F. Hilt, Warren, Samuel Milliken, W. Scarboro	Eggs on apple trees; wingless females on side of house; larvæ feeding on foliage of apple trees.
2	The Angoumois Grain Moth	*Gelechia cerealella*, L	F. L. Harvey	Found in *Sure Pop* Shaker Corn in a store in Orono
3	The Stalk Borer	*Gortyna nitela*, Guen.	H. B. Whipple, Bingham	Boring potato stalks.
4	The Io Emperor Moth	*Hyperchiria Io* (Linn)	F. H. Parlin, East Winthrop	
5	The Lime-tree Winter moth	*Hybernia tiliaria*, Harris	F. W. Hilt, Warren	With the females of the Fall canker worm crawling on the side of a house.
6	The Red-humped Apple-tree Caterpillar	*Œdemasia concinna*, (Sm. and Abb.)	F. L. Harvey, College orchard, Miss May Thurlow Farrow, Centre Belmont	Feeding on foliage of apple trees. See Station Report, 1890, page 135.

7	THE GREAT AMERICAN TIGER MOTH	*Arctia Americana*, Pack	D. H. Knowlton, Farmington	This is a rare moth in Maine. Of no special economic importance.
8	THE APPLE LEAF BUCCU LATRIN	*Bucculatrix Pomifoliella*, Clemens.	D. P. Boynton, Monmouth	Injuring the foliage of apple trees.
9	THE DISIPPUS BUTTERFLY	*Limenitis disippus*, Godt	Fred B. Pike, Cornish	Feeding on willows.
10	THE PLUM CURCULIO	*Conotrachelus nenuphar*, Herbst	F. Frank Jones, Portland	Several varieties of pears showing the cuts of the plum curculio.
11	THE STRIPED SQUASH BEETLE	*Diabrotica vittata*, Fabr	J. W. Black, Searsport	Obtained from Mr. C. A. Woods.
12	ROVE BEETLE	*Anegrophorus planus*, Lec	J. W. Black, Searsport, from C. A. Woods, Searsport	Feeding on the starchy matter of ears of corn that had been injured by the Corn Worm. See Experiment Station Report, 1893, p. 192.
13	FOUR SPOTTED PITHYOPHAGUS	*Pithyophagus 4 quttatus*	J. W. Black, Searsport, from C. A. Woods, Searsport	With the above feeding upon the exuded milk of corn attacked by the Corn Worm.
14	THE WHITE GRUB OR MAY BEETLE	*Lachnosterna fusca*, Frohl	J. L. Wale, Bridgton	Destroying meadows.
15	BLACK CANTHARIS	*Cantharis atrata*	H. B. Gray, Blue Hill	Feeding on potato vines.
16	BEAN WEEVIL	*Bruchus obtectus*, Say	Samuel Libby, Orono	Working in stored beans.
17	THE PEAR BLIGHT BEETLE	*Xyleborus pyri*, Peck,= *Xyleborus dispar*, Fabr	J. M. Allen, North Sedgwick, Dr. Twitchell Augusta	Boring in the limbs of apple trees.
18	THE HORN FLY	*Haematobia serrata*	A. T. Wing, North Fayette	See Experiment Station Report, 1892, p. 131.
19	THE CARROT FLY	*Psila rosae*, Fab	C. H. Morrell, Pittsfield	Larvæ badly infesting stored carrots. New to United States.
20	THE BEET OR MANGOLD FLY	*Anthomyia betae*, Curtis	O. T. Goodrich, Orono, F. L. Harvey, Orono	Feeding on the pulp of beet leaves reducing them to a dry papery skin.
21	OYSTER SHELL BARK LOUSE	*Mytilaspis pomorum*, Bouché	Miss Georgine V. Weber, Phillips	On apple trees. See Experiment Station Report, 1888, p. 157.
22	THE CURRANT PLANT LOUSE	*Aphis ribis*, L	Chas. P. Kittredge, Milo	Attacking gooseberry leaves.
23	THE COTTONY MAPLE SCALE	*Pulvinaria innumerabilis*, Rathvon	C. M. Randlette, Richmond	Causing clusters of second growth leaves.
				On maple leaves.

BOTANY.

Bean Anthracnose.

Colletotrichium Lindemuthianum. (Sacc & Magn) Briosa & Cavara.

Fig. 1—Bean Anthracnose, pod showing pits formed by the disease (original)

The above disease of the bean has been quite common in gardens and fields about Orono for the past seven years and we presume it is prevalent throughout the State. It was unusually bad the past season, and specimens were received from distant localities and inquiries made regarding it. It is probably the worst disease of the bean and as its ravages can be largely controlled by proper precautions and treatment, the following consideration of the fungus may prove helpful in combating it. The Bean Anthracnose is a parasitic fungus attacking the stem, leaves and pods of both bush and pole beans, producing, especially on the pods, sunken brownish pits or spots surrounded by a reddish brown border. See Fig. 1. In the central part of these pits are little pinkish dots which are the spore masses that have exuded from below. The spores are held together by a gummy substance that is soluble in water and they may be liberated by dew or rain or excessive moisture and then are free to be blown by the wind to healthy plants, where they germinate and spread the disease. The disease is worst upon the white podded bush and pole beans but will also attack the more hardy varieties. The past season it was quite bad upon yellow eyes in the field. We lost the greater part of our garden crop of German Wax the past season, the pods becoming so covered with pits before they were large enough to pick as to be worthless. The effects of this disease are to lessen the stand when it destroys the seedlings; to dwarf the plants and make the pods swollen and when it spots the pods to render them unfit for snap beans, also to finally injure the bean in the pods. This disease may originate from infected seed or, we think, it may live over winter in the beans and pods that are left in the garden. When infected seed is planted the disease shows itself early in the seedlings. Much of the seed of German Wax beans offered for sale is infected. The past season fully half of the seedlings in our garden were affected

when they appeared above ground and not more than two thirds of the seed came up. The remaining plants were dwarfed and early showed the presence of the disease. We procured new seed and made a second planting.

We have *purchased* our seed for the past seven years from that offered for sale by prominent dealers and have never had a crop free from the disease. It is common among gardeners to leave the bushes with the diseased pods upon them to rot on the ground, and to plant a second crop in the same place. We practice rotation of crops even in the garden with good results. It is a good practice to clear a garden in the fall of all refuse and carefully burn it. By doing this, fungi that live in the decaying organic matter are destroyed, along with hybernating insect pests. Beans should be planted on a light dry soil, in hills, or if in rows far enough apart to give good circulation of air. Moisture favors the growth of *Anthracnose* and other bean diseases. Care should be taken not to hoe beans after a rain or when the dew is on for the dirt that sticks to the leaves is liable to contain spores that will germinate and rapidly spread the disease. Professor Jordan showed us some badly spotted pods that were apparently free from the disease when purchased in the Orono market a day or two before.

If possible secure seed from your own, or a neighbor's field that was free from disease. It is hazardous to plant seed from an infested field. If obliged to take seed from a field that has been diseased pains should be taken to select pods from plants that have escaped the disease. All beans that show sunken pits, discolored patches, or are even wrinkled or blistered should be rejected. Diseased seedlings should be pulled as early as possible and removed from the field or burned, as the fungus will ripen its spores in the decaying plant. Some practice spraying beans with *Bordeaux mixture* early in the season, and claim that the fungus is controlled by it. The following precautions should materially lessen the disease:

I. Select good seed, rejecting all beans that seem at all unsound.

II. Should the disease appear in the young beans carefully destroy all affected seedlings.

III. If convenient spray early with Bordeaux mixture and repeat the application if needed before the pods form.

IV. Do not plant on ground that has borne an infected crop the past season.

V. Plant on a dry soil in hills or in rows far enough apart to admit air freely. Hoe when the ground and foliage are dry.

Tomato Anthracnose.

Colletotrichum phomoides, Sacc.

This fungus appeared last fall in the station garden upon ripening and fully ripe tomatoes and did considerable damage. Tomatoes that were apparently sound developed the disease rapidly after they were gathered. This fungus is capable of doing much damage to the ripening crop and the ripe fruit can not be kept any time or marketed. We understand from Professor Munson that the disease has done damage elsewhere in the State. Professor Chester described this fungus as *C. lycopersici*, n. s p. in the Fourth Report of the Delaware Station, but in the Fifth Report of the same station, p. 80, 1892, he refers the fungus back to *C. phomoides*, Sacc. Our species is the same as the one considered by Professor Chester, as we sent specimens to him for comparison. He has kindly loaned us the fine cuts which are used to illustrate this article.

Professor Chester is of the opinion that the characters used by botanists to separate the genera *Colletotrichum and Gloesporium*, viz.: the presence or absence of setæ in the fruiting tufts, is evanescent. If this should be established the genus *Colletotrichum* would be merged into *Gloesporium*. The investigations of Miss Southworth, Professor Halsted and Professor Chester indicate that several forms of *Gloesporium* separated as species on account of living on different host plants will have to be merged, or that there is a species of *Gloesporium one and the same*, capable of a wide range of parasitism and of producing *Anthracnose* on a variety of hosts. It looks as though careful laboratory methods would make havoc with the present nomenclature of fungi, by merging stages of the life history of forms and uniting species that have been separated on the principle, that each host harbors its peculiar parasites. The above is only of importance to mycologists. The characters and treatment are of more interest to the grower of tomatoes.

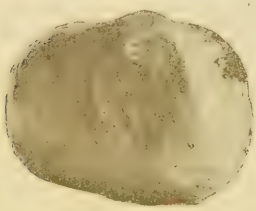


Fig. 2. Tomato Affected by Anthracnose. Colletotrichum phomoides, Sacc.

CHARACTERS.

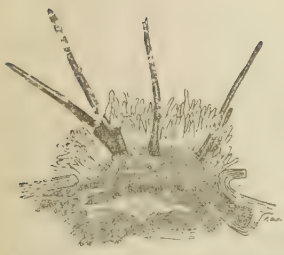


Fig. 3. A fruiting tuft of Colletotrichum phomoides, Sacc. Tomato Anthracnose.

This disease makes its appearance upon ripening or fully ripe tomatoes upon the vines or develops rapidly upon gathered fruit. It appears on the tomatoes as rounded, sunken, discolored, wrinkled spots with a black centre. See Fig. 2. Contiguous spots become confluent forming diseased areas. An examination of these dark parts in the diseased areas, discloses numerous microscopic, oblong bodies, the *spores* of the fungus. See Fig. 4. These spores reproduce the disease. Prof. Chester found that these spores inserted under the skin of healthy tomatoes would rapidly cause the disease. Not being able to develop the disease by putting the spores on the unbroken skin of the green and ripe tomatoes would indicate that the disease is an internal parasite and can not be reached by spraying with Potassium Sulphide as is recommended by Mr. Bragg of the Oregon Station in a recent bulletin.

Fig. 4. A. Mature spore. B. Germinating spore of Colletotrichum phomoides, Sacc.

This disease opens the way for the attack of other species of fungi that hasten the decay.

Fig. 3. shows a cross section of one of the diseased spots highly magnified.

REMEDIES.

1. Spray the vines and young fruit with Potassium Sulphide (Liver of Sulphur)—formula.—Dissolve seven ounces of Potassium Sulphide in twenty-two gallons of water and apply with a spraying apparatus. As stated above this may not be useful for this disease but is regarded a remedy for external tomato fungi.

2. Gather all diseased vines and tomatoes and burn them.

3. Change the location of the tomato patch if the crop has been affected.

4. Do not take seed for planting from diseased tomatoes.

Potato and Beet Scab.

Oospora scabies, Thaxter.

The scab of potatoes and beets has been quite prevalent the past season. The ordinary disease of potatoes and beets known as "scab" has been demonstrated by Dr. Thaxter to be due to the same fungus, the species named above. Now that the cause is known experiments for checking the disease can be conducted upon a rational basis. Professor Bolley exhibited at the World's Fair, Chicago, in the exhibit of the office of experiment stations, two jars of potatoes grown under similar conditions from scabby seed. One lot was treated with a dilute solution of corrosive sublimate and the other lot was untreated. The former lot was comparatively free from scab and well grown. The latter badly scabbed and dwarfed.

This would indicate that scabby seed may be the cause of the disease and that clean seed should be planted. It would also follow that scabby seed *treated* will produce much better potatoes than scabby seed *untreated*.

We feel positive that the disease cannot be controlled merely by planting clean seed. The last season we planted clean seed upon soil that had not grown potatoes for two years and raised a badly scabbed crop. It seems certain that this disease may live in the organic matter of the soil even more than one year or else has other hosts which have not been discovered upon which it maintains itself.

Will treating clean seed with corrosive sublimate give a better crop than clean seed untreated? If not we see no great use for it, for clean seed is usually obtainable.

Experiments to show the vitality of this fungus in soil not growing potatoes are desirable in order to learn whether a system of rotation may not clean the soil of the disease. Experiments should be conducted with clean seed upon grass lands in order to learn whether they are free from the fungus and settle the question whether newly turned grass land is better for potatoes. The study of fertilizers in relation to the introduction of this disease is important. Considerable more study upon the conditions of growth of this fungus is necessary.

WESTERN PLANTAIN.

Plantago Patigonica, var. aristata, Gray

Figs. a, b and c show spikes in different stages of growth. Fig. 1. Back view of flower with calyx removed. Fig. 2, front views with calyx and basal bract. Figs. 3 and 4, portions of capsules. Figs. 5 and 6, dorsal and ventral views of the seed.

Western Plantain.

Plantago Patigonica, var. aristata, Gray.

Specimens of the above plant were received the past season from Mrs A. M Pikes, East Madison, Somerset county, and found growing in an oat field. This plant belongs to the *Order Plantaginaceæ* and is a near relative of the English Plantain considered in Experiment Station Report, 1890, p. 119. It was probably introduced with the seed. A few specimens were found growing on the college campus a year or two ago, introduced with grass seed, but they were not allowed to drop their seed. This plant is widely distributed in South and North America and in the West is a bad weed It presents a number of varieties besides the one named above. As it has become established on Martha's Vineyard and about Boston it would no doubt find a congenial home in Southern Maine, and this is written to call attention to it.

It can never become so bad a weed as its relative, the English Plantain, which has a strong foothold in some parts of Maine as it is an *annual* and could be eradicated in a single season if prevented from seeding. It may be known by the following description:

About a foot high, having usually several slender, naked, flowering stalks which start from a cluster of leaves near the ground and bear on their top a close spike of flowers. The leaves are narrow, from three to five inches long, and bear a few nearly prominent parallel ribs. The variety under consideration is clothed with silky hairs and below each flower in the spike is a bract two or three times the length of the flower The seed are boat-shaped as in the English Plantain. The seeds germinate the same season they ripen and the young plants mature the next season. It seeds profusely and a few plants would give it a good start. That the plant may be readily detected we reproduce from the United States Agricultural Report, 1888, plate XI, a cut of this weed, which is shown on the opposite page.

ENTOMOLOGY.

The Angoumois Grain Moth.

(*Gelechia cerealella*, Linn.)

Order Lepidoptera: Family Tineidæ.

The above insect was detected the past season as detailed below. Experiments made by Mr. F. M. Webster show that the New England climate will not destroy this pest but only check its depredations during cold weather. His experiments also show that the pest can be destroyed by a temperature of 130° Fah. kept up for four or five hours. The accompanying cuts show the life history of this moth, and the nature of its work. Below we give an article upon this insect contributed to the *Maine Farmer* by the writer.

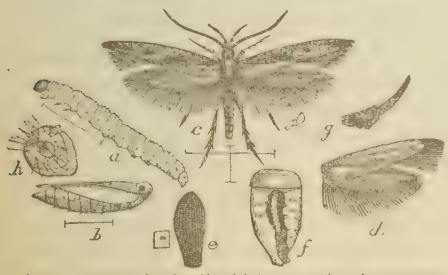


FIG. 5. Stages in the life history of the Angoumois Grain moth, Gelechia cerealella, L.

Editor Maine Farmer: My attention was called a few days ago to the above insect found in great numbers in boxed Shaker rice

pop corn, put up by R. H. Wright, Albany, N. Y., and obtained for retail in Orono from a wholesale house in Bangor. As this is one of the most destructive insects known to wheat, oats, barley and Indian corn, it seems desirable that attention be called to it. Upon opening the boxes swarms of full fledged moths were found on the top of the corn, and made their escape into the room. The kernels of corn each contained small circular holes, and the most of the starchy matter was eaten, leaving only the shell. Mixed with the corn were a large number of dead moths. The party who found the moths let the live ones from several boxes of corn escape in the store, and when I told him it was a bad pest, he said they would all die, as the store was cold nights, and that he had burned all the corn. Though this insect was introduced from France, and has done more damage South than North, yet it is undaunted by a cold climate, and would be capable of doing much damage in stored grain in Maine. This insect was abundant in the grain exhibits at the World's Fair the past season. To burn the corn after the moths had all escaped was useless. That this insect may be better known, so that precautions can be taken against it, we give the following regarding its life history:

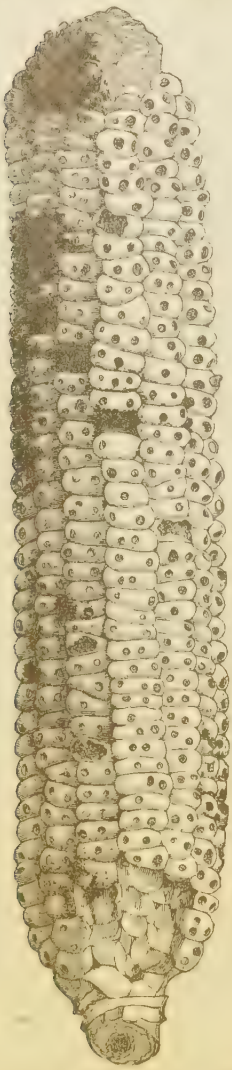


Fig. 6. Work of the Angoumois Grain-moth, Gelechia cerealella, L.

Perfect insect, a small moth with pointed wings, that spread between a half and three-quarters of an inch. Fore-wing pale shining ochre, with a grayish or brownish gray streak in the folds at the base, and a few scales of the same color toward the tip of the wing on the margin. Hind wings grayish ochre, and bearing a fringe of the same color on the border. *Larva*, a smooth, white worm, attacking the kernels, and consuming the inside, leaving the shell, and when full fed transforming to the *pupa* state in the grain, and finally emerging as a moth through a small hole in the kernel.

REMEDIES.

Bisulphide of carbon is now quite largely used to destroy insects infesting stored grains. In France they put the grain into an *insect* mill something like a peanut or coffee roaster, and raise the temperature of the grain high enough to kill the moths, eggs and larvæ. When the quantity of grain is small, it might be thrown into *hot water* or *heated*, and then fed to fowls. The work of this insect resembles in its effects that of the pea weevil, only the hole made by the moth is smaller, and so far as we know these insects never encroach upon each other's domain, the moth infesting the seeds of graminaceous plants, while the pea weevil is partial to legumes. Whether this corn was infested before it left the *Shakers*, or whether it lay in the wholesale houses in Bangor during the past summer, and was infested by moths of home production we do not know, but the moth is here *sure pop*, and we will have to look after it.

F. L. HARVEY.

ORONO, December 11th.

THE LIME-TREE WINTER-MOTH.

Hybernia Tiliaria, Harris.

Order Lepidoptera: Family Geometridae.

Among some specimens of female Canker-worms received from Mr. F. W. Hilt of Warren, Maine, were several wingless females of the above species. The specimens were found on the side of a house where they had probably crawled to lay their eggs or meet the males. As the Canker-worm is very bad in Maine and as this insect has similar habits they should be distinguished.

DESCRIPTION.

Eggs pale yellow, oval and marked with a net work of raised lines. They can be distinguished from the eggs of the Canker-worm by their color and form. (See Experiment Station Report, 1888, p. 167, Fig. 20.) The eggs are laid in similar situations as those of the Canker-worm. As the females of both species had

commenced to lay eggs in the box in which they were sent we concluded they were probably crawling up the side of the house to deposit the eggs.

Larva, when full grown, about an inch and a quarter long. Head dull red with a V-shaped mark on the front, yellow above and marked with many longitudinal black lines; the under side paler. Like the larva of the Canker-worm it is a *span* or *inch* worm but larger than the caterpillar of that species. The accompanying cut (Fig. 7) shows the larvae feeding and at rest.

FIG. 7. The Lime-tree Winter-moth, Hybernia tiliaria, Harris. Male, wingless female and larvae.

Female Moth, wingless, spider-like, yellowish white, sides marked with black dots, each ring of the body, excepting the last, bears two black dots, which has only one. Head black in front and the legs ringed with black. Antennae thread like. Ovipositor jointed and retractile. The larger size, the spotted back and black rings on the legs readily distinguish this from the wingless females of the fall and spring Canker-worms. Fig. 7 shows the wingless female about natural size.

Male Moth, expanse of fore wings an inch and a half. Color, rusty buff sprinkled with brownish dots and with two transverse brown wavy lines, the inner most distinct. Between the bands and near the anterior edge is usually a brownish dot. Hind wings paler. Body color of fore wings. The antennæ are feathered. Like most of the moths of the inch worms the wings are very delicate. The male moth about natural size is shown in Fig. 7. The moths of the Canker-worm would be on the wing at the same time but they are smaller.

LIFE HISTORY.

The eggs hatch early in the spring and the young larvae feed upon the foliage of the apple tree, basswood, elm, hickory, etc., and are full grown about the middle of June, when they usually let themselves down by a silken thread, enter the ground about five or six inches, form a little oblong cell within which they change to the chrysalis state. In October or November (sometimes not until the following spring) when the moths appear. The wingless females climb the trees or other objects where they meet the winged males, pair and soon deposit the eggs in clusters, (usually upon the branches of the tree they have infested,) completing the life history.

REMEDIES.

The life history of this species is so nearly like that of the Canker-worm that the remedies suggested for that insect are applicable to this. It has never done as much damage as the Canker-worm but it is capable of doing much injury to the foliage of apple trees and from the specimens received we should judge that it is quite abundant about Warren, Maine.

The Apple-Leae Bucculatrix.

Bucculatrix Pomifoliella Clemmens.

Order Lepidoptera: Family Tineidæ.

We received from Mr. D. P Boynton, Monmouth, Me., a lot of apple tree leaves badly eaten by the larvæ of the above moth. In the box were quite a number of the larvæ and cocoons. This is the first time we have seen this species in Maine and as it is capable of doing considerable damage to the foliage of apple trees, we give the following account of it, so that it may be known and measures adopted to prevent it spreading.

HISTORY.

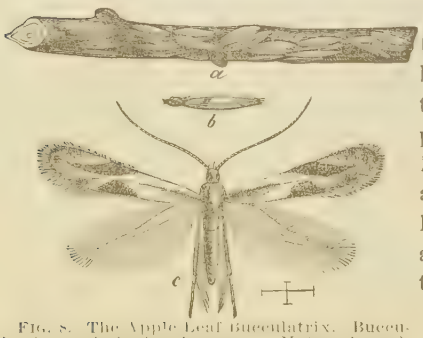


Fig. 8. The Apple Leaf Bucculatrix. Bucculatrix pomifoliella, Clemmens. Moth enlarged, cocoons natural size and enlarged.

This moth was described by Clemens in 1860 It is known to be widely distributed having been reported from Texas, Missouri, Massachusetts, New York and now from Maine. It has done considerable damage to the foliage of apple trees especially in New York.

DESCRIPTION.

Eggs—So far as we know the eggs of this species have never been described. They must be quite small as the cocoons of this diminutive moth have been mistaken for insect eggs. They are said to be laid upon the leaves. We have never seen them.

Larva—About one-half inch long when mature, cylindrical, tapering at both ends. Joints of the body rounded and prominent, color dark yellowish with a greenish tinge, and reddish shades on the anterior segments. Body armed with short black hairs which are more numerous on the back of the first segment. Head small, brown and elipsoidal. The larvæ are active and when disturbed suspend themselves by a silken thread.

Cocoons—Dirty white, slender, about one-fourth inch long, ribbed longitudinally by about six prominent ridges, oblong, tapering and thinning at both ends, flattened on the side to which it is attached. Usually fastened to the twigs and branches in groups as

shown in Fig. 8 a. Fig 8 b shows one of the cocoons enlarged. The specimens we had were confined in a box and the cocoons were attached to the leaves and side of the box. If it can be shown that in nature the cocoons are never attached to the leaves it would indicate a remarkable instinct, for if attached to the leaves which fall they would probably be destroyed, while attached to the twigs they would be safe during the winter. The cocoons contain the

Chrysalis which is dark brown, rough, punctured on the back, twelve hundredths of an inch long. When ready to transform the chrysalis works itself partly out of the cocoon and the moth comes forth.

Perfect insect a small moth that is only about one-fourth inch expanse of wings. Fore wings whitish tinged with pale yellow and dusty brown. On the middle of the inner margin is a conspicuous oval brown spot. A wide streak of the same color on the opposite margin which extends nearly to the end of the wing where it tapers and points to a small circular brown spot near the tip. The moth much enlarged is shown in Fig 8 c. The hair lines to the right show the natural size.

LIFE HISTORY.

This insect spends the winter in the chrysalis state in the cocoons usually attached to the twigs and branches of the host plant. There is reason to believe that the larvæ when full grown sometimes desert the host plant and form their cocoons on other plants close by. About the time the leaves unfold the moths come forth and lay their eggs upon the tender foliage. The larvæ are full grown in July. The specimens sent us in July were in the larval form and went into the chrysalis state in August and have not yet (January) emerged, which would indicate only one brood in Maine. Prof. Riley thinks there are two or three broods in the latitude of St. Louis, Mo. In the latitude of New York, Prof. Lentner states that there are two broods, one in July and one in September. Our specimens would belong to the July brood and possibly may be diseased and may not emerge. Possibly we have two broods in Maine. In September or October the cocoons are formed in which the pupæ spend the winter. The larvæ feed externally upon the foliage, at least the leaves we received had the upper epidermis and pulp eaten away in patches, the veins and lower epidermis intact.

REMEDIES.

Natural—This small moth is preyed upon by several parasites that attack the larvæ and hold the pest in check. Some of the cocoons probably suffer somewhat from inclemency of the weather. Possibly birds may eat them but we find no record of observations.

Artificial—(a) Jar the trees when the larvæ are full grown and they will suspend themselves by threads and can be swept down by a broom and killed by hot water or crushed.

(b) Apply kerosene emulsion with a spraying pump to the branches in winter that bear the cocoons. The same application might be made for the first brood when the foliage is on. Strong soap suds alone probably would kill them.

(c) If in small numbers the cocoons can be removed during the winter months by the hand.

The Disippus Butterfly.

Limenitis disippus, Godt.

Order Lepidoptera.

We receive the larvæ of the above species occasionally on account of the fact, that the second brood of larvæ hybernate when about half grown and make a beautiful hybernaculum that is sure to attract attention, also the larvæ is highly ornamented with colors and tubercles, and quite noticeable. The eggs are beautifully reticulated, small and laid on the under side of the leaf near the end. Most people are surprised to learn that those grotesque larvæ and odd hybernacula pertain to one of our common butter-

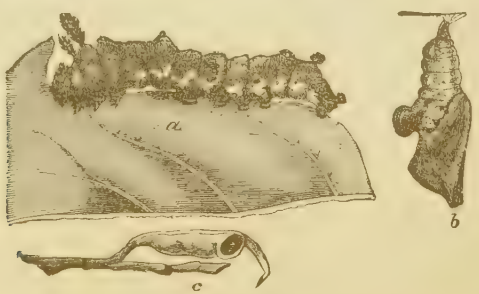


Fig. 9.

flies. Fig. 9 a shows the form of the full grown larvæ, b, the chrysalis, c, the hybernaculum in which the half grown larvæ of the fall

brood spends the winter. Fig. 10 shows the orange-red butterfly full size. The wings bear heavy black veins and a black border spotted with white.

FIG. 10.

LIFE HISTORY.

The hybernating larvæ complete their growth go into the chrysalis state and the butterflies are on the wing by July. These deposit their eggs sometimes on the leaves of plums but usually upon willow or poplar. The eggs soon hatch and in a month the larvæ are full grown, enter the chrysalis state and in a short time the second brood of butterflies appear. These lay eggs which soon hatch and when the larvæ are less than half grown they make hybernacula from the leaves in which they spend the winter.

THE MAY BEETLE.

Lachnosterna fusca, (Frohl.)

Order Coleoptera: Family Scarabæidæ.

We received the following letter last September in reference to the above insert:

"BRIDGTON, Maine, September 18, 1893.

Professor Harvey:

DEAR SIR—I send you specimens of a worm that is doing a great amount of damage to the farms in this vicinity. There are many acres of grass land in this town where a good crop of Timothy was cut the present season which now show hardly a green blade of grass. These worms are found just below the surface

where they feed upon the roots of Timothy. Can you tell us the name of the worm, its habits and if there is any way of extermination or curtailing its ravages? Will you please answer at once as we wish to find out how to treat the land this autumn.

"An early reply will greatly interest many farmers in this section of the State. Respectfully, J. L. Wales."

In response we sent Mr. Wales what information we had regarding the methods of coping with this pest. Mr. Wales published a newspaper article on this insect from which we make extracts to show the extent of the ravages of this insect in the State.

WHAT SHALL BE DONE WITH THE "WHITE GRUB."

This is becoming a very serious question with many farmers and gardeners at the present day in the town of Bridgton and vicinity.

A few days since Mr. A. M. Thomes, the owner of a nice farm on High street invited me to visit his grass fields. In one corner of a fine, large field which had borne a heavy crop of Timothy the present season, we found rather more than a half-acre upon which there was not visible a sign of vegetable life. What had composed the turf or sward could be stripped off and rolled up like a carpet, leaving the soil naked and brown and bringing to light upon each square foot of surface from a dozen to twenty flat white grubs. Several of these were put in alcohol and sent to Prof. F. L. Harvey of the State Agricultural College at Orono, who kindly and promptly sent what information he had at hand relative to the name, habits, and remedies, for this pest of the farmer. The grub especially loves to feed upon the roots of Timothy or herds grass, as may be seen upon the farms of Mr. Thomes, M. B. Stone, Nathan Palmer, Geo. Hilton and many others; it also loves the roots of the strawberry. Mr S. E. Lee of High street lost about one thousand fine strawberry plants the present season. The roots of corn are often devoured by the grub as may be seen on the farm of Mr. Geo. Chaplin, Naples Mr. John Palmer of South Bridgton lost a part of his potato crop in the same way.

Complaints from other parties and from other sections of the State show that the "White Grub" is wide spread and doing much damage in the State.

This insect is so familiar to everybody that we will take space to give an account of its life history but publish herewith a cut

so as to show clearly what insect is meant. Figure 11. 1 shows the pupa, 2 the grub, 3 and 4 side and dorsal views of the beetle. This insect is known as the "May Beetle," "June Bug" and "White Grub." In the larvæ state it feeds upon the roots of plants having done much damage to grass lands and especially to strawberry vines The beetle feeds upon the foliage of trees and where abundant often entirely stripping them of their leaves. The beetle is attracted by lights and is a frequent evening visitor to our living rooms while on the wing. The impression prevails that the eggs are laid on grass near the roots though perhaps this matter may bear further study.

FIG. 11. The May Beetle. Lachnosterna fusca, (Frohl.) 1 pupa, 2 larvæ, 3 and 4 Beetle.

REMEDIES.

The Department of Agriculture at Washington, D. C., has conducted some experiments to show that kerosene emulsion liberally applied to the soil infested with "white grubs" will destroy them. The remedy would be too troublesome and expensive for application in large meadows but for small areas is worthy of trial. We extract the following from Prof Riley's letter regarding the subject: "The application of kerosene emulsion for white grubs is impracticable over very large areas owing to the necessity of washing the emulsion into the soil to considerable depth by a copious application of water, unless the application can be made with tolerable certainty of its being followed by slow and continuous rains such as will carry it into the soil gradually without washing it away. These conditions will not often be available at the time wanted, but for all limited applications as to lawns or limited patches of ground affected by the larvæ, there is no better remedy than the kerosene emulsion treatment. I have no accurate data as to the amount required per acre but if the emulsion is applied sufficiently to thoroughly wet the surface of the soil to the depth of an inch or

more and then carried down by applications of water to a depth of about eight inches during the next two or three days, the treatment will certainly prove effective. The amount necessary will vary with the different soils, both of the emulsion and the water applied later on to carry it down, easily permeable, sandy soils requiring less than denser clay soils.

Professor J. B. Smith has found potash fertilizers in the form of *Kainit*, applied as a top dressing efficacious against root affecting insects, such as wire worms. We wrote Professor Smith regarding the matter and below is his reply.

New Brunswick, N. J., September 22, 1893.

Dear Sir—Your card of the 20th inst., is at hand. The latest on Lachnosterna you will find in Forbes' 17th Illustrated Report, issued in 1891. I have had no personal experience with these insects from the economic side, and cannot give you any positive or tried suggestions. You know my hobby, and if the matter came to me in New Jersey, I would advise heavy top dressings of Kainit and Nitrate of Soda applied in combination after the flight of the beetles is over in spring, or the former alone applied early in September. Yours very truly, John B. Smith.

Professor F. L. Harvey, Orono, Maine.

Mr. Wales in his article suggests the following: "In the days of our fathers when the 'burnt pieces' were lighted up at night time by the partially extinguished fires, the farms and orchards were not infested by so many hostile enemies; and would not fires kindled in the neighborhood of orchards for a few evenings in late May or early June destroy the beetles and thus prevent the production of the white grub?"

The rooting propensities of swine can be put to practical account in destroying this pest. If I had meadow land on which the sod was dead and could be rolled up like a carpet, I would construct a movable fence and enclose the small areas and turn in a few hogs. The land would have to be reseeded and the swine could do no damage, and they would probably devour a large number of the grubs

Skunks and crows are known to be enemies of the "white grubs" but owing to the demand by furriers for the pelts of the former and our anti-crows law against the latter we have not much to hope for in those directions.

We hope the farmers whose fields are infested will try some of these measures. There is one consolation and that is the life history of this pest is completed in three years and it would not probably lay its eggs on the same ground again, but seek some new field of conquest.

The Bean Weevil.

Bruchus obtectus, Say.

Order Coleoptera: Family Bruchidæ.

We received specimens of beans infested by the above insect from Hon. Samuel Libby, Orono. He gives the following interesting history regarding them: 'The beans are of the horticultural variety and were gathered in the pods when ripe in September, 1891, and taken to my store where they lay until October, 1891. I then sorted out those that had six beans in a pod for seed and also those with five beans in a pod for second choice. The lot having five beans in a pod were put in an open basket in the store. They remained there during the summer of 1892 and about January 1, 1893 I had occasion to examine them and found they were infested. About one-tenth of the pods had holes in them and I found fine dust falling from the beans, and saw the holes in them. I also noticed small black objects in the basket. Not knowing that there was a bean weevil that worked on beans as the pea weevil does on peas I laid them aside for you.

The pods having six beans in them were shelled and planted in the spring of 1892 and showed no signs of weevil work. I have grown horticultural beans for twenty years and have always raised my own seed. In 1891, 4, planted beans obtained elsewhere and the beetle might have been introduced with that seed. "The crop of 1892 shows no evidence of weevil work."

We examined the specimens submitted and found them to be *Bruchus obtectus*, Say. The beans contained eggs; minute larvæ just hatched; larvæ one-third, one-half and full grown; pupæ in various stages of development; full grown pale colored beetles; some full colored ready to emerge; others free in the basket alive and some apparently dead. There were as many as twenty individuals in some of the beans. There were numerous holes in some of the beans from which the beetles had escaped, also many oval

translucent places where the coating of the bean had been made thin by the beetles indicating their location within. The inside of some of the beans was completely eaten and only the powdery excreta remaining. We wish to add our testimony to that of Popenoe, Schwartz and Lintner that successive generations of this insect occur in stored beans, and also that if the food supply does not become exhausted they may survive into the *second season*. They will eat cotyledons, radicle and plumule. Several specimens showed the cotyledons entirely detach from the radicle and it intact. We believe the radicle is rejected not because it is less desirable for food but on account of it being small and nearly isolated from the bean mass. We found one specimen with the cotyledons nearly intact and the radicle eaten, its place being occupied by a well fed larva. In some specimens *nothing* remained excepting the seed coats filled with powdery excreta.

It has not been clearly shown that the beetles will not fly or crawl to new lots of stored beans and infest them.

Or in other words it is not known whether beans may become infested after they are stored by the beetles laying their eggs upon them. The general belief is that the beetles confine their attacks to the lot of beans infested and that they spread during the summer through the agency of eggs laid on the growing pods.

Prof. Lintner has shown that the beetles will lay their eggs upon dry beans and that in the infested lot that the young larvæ will gnaw into them and perfect themselves.

The fact that a part of the lot of beans which Mr. Libby took to his store was not infested when shelled the next spring would lead one to suspect that the others may have been infested by beetles getting into them after they were stored. The holes in the pods may have been made for the entrance of beetles as well as for their exit. The holes being in the pods shows that the beetles as well as the larvæ have adequate gnawing powers. The only thing that would prevent infection this way would be the sluggish habits of the beetles. Those we had in a warm room in January were quite active. They did not fly but crawled rapidly. Prof. Lintner's observations show clearly that they may spread from the beans originally infested in a lot to the others stored with them. It is also important to know whether the beetles that mature at all seasons of the year may not fly to new lots of stored beans and infest them.

The fact that successive generations occur in stored beans; that sound beans in the same lot may become infested and that possibly new lots may also become infested, makes this weevil a more formidable pest than was formerly supposed.

Beans are largely grown and consumed in Maine and should this insect become common much damage might be done. Below we give its history, characters and remedies.

HISTORY.

This species is probably not native but was introduced as early as 1860, at least, possibly from *Asia*. It would seem that it has erroneously been considered the same as *B. obsoletus*, Say., bred from *Astragalus* seeds from Indiana as early as 1831. This view is strengthened by the fact that it was found in 1876 at Philadelphia in beans from various countries from both continents. At present it is cosmopolitan. It was first noticed in Rhode Island in 1860 by Dr. Fitch, who described it as *Bruchus Fabæ*. Within the next ten years it was carried to nearly all parts of the United States. In 1870 it was known from several of the New England States. So far as we know it has not previously been reported from Maine. Professor Fletcher has not found it in Canada. As the beetles are sluggish and disinclined to fly it is mainly distributed in infested beans. Those wishing a fuller consideration of this insect will find an interesting summary of the facts known regarding it in Professor Lintner's 7th Report of the Injurious and Other Insects of the State of New York, p. 255.

Characters—A small beetle that would be usually found infesting beans or associated with them. See Fig. 12. There are two

FIG. 12. Bean Weevil, much magnified.

closely related species of *Bruchus* that have been found infesting beans in this country. The above species is by far the most

common. It is one-tenth of an inch long, oval in form, head bent downward and more or less concealed from above, prolonged into a short, squarely-cut beak. Antennæ distinctly jointed, enlarged at the tip, the four basal and the terminal joints reddish or yellowish. Thorax and abdomen about the same width where they join. Wing covers marked by ten impressed and punctured lines in flattened ribs, which are clothed with a short pubescence, arranged in yellowish, black and whitish spots and lines—the white lines more distinct on the third rib. The abdomen is pale, dull yellow, with a black band on the fore part of each joint. It projects beyond the wing covers and that part is obscure grayish with a faint, medium whitish stripe. The hind thighs near their end armed with a long and two short spines. Feet reddish.

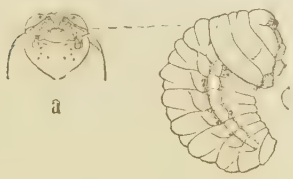


FIG. 13.

The larvæ are white and broadly oval, see Fig. 13. The eggs white, thicker at one end and about three times as long as wide.

The work of this insect appear on the surface of the beans as small holes from which the beetles have escaped, and small oval, translucent spots on the surface over the cells that contain bettles that have not emerged. The work is shown in Fig. 14. The inside of the bean in badly infested specimens is entirely converted into a powdery mass of excreta. Often the beans will contain larvæ in various stages of growth and also beetles. Fig. 15 shows the pupa. Fig. 16 shows the closely related Pea Weevil, enlarged and natural size, which is given for comparison.

FIG. 15. Bean Weevil pupa.

FIG. 14. Bean Weevil. Work of the insect.

FIG. 16. Pea Weevil. a, natural size and enlarged; b, work of the insect.

LIFE HISTORY.

The eggs are laid upon the young bean pods after the flowers have withered, at any point, and sometimes many on a pod. The eggs hatch in a few days and the young larvæ enters the growing bean. It lives upon the substance of the bean making an excavation somewhat larger than itself in which it transforms to the pupa, finally to the beetle state. The beetles may emerge in the fall or at any time during the winter, lay eggs, which hatch and the larvæ enter the same beans or new ones. Successive generations may occur until the food supply is exhausted. Those beetles on the wing during the summer lay their eggs in the pods of the growing crop. The length of time required for the transformations has not been studied but probably is variable with circumstances. We found quite a number of dead beetles within the cells in the beans.

PRECAUTIONS

Experiments have shown that beans infested with *weevils* will not all sprout and that the plants from them are sickly and do not produce a full crop. It is therefore best not to plant them. It is believed upon good authority that beans containing the weevils in the beetle form are probably injurious and unfit food for man or beast.

REMEDIES.

If beans are found to be badly infested so as to be useless for food or seed, they should be *burned at once* so as to prevent the escape of the beetles.

Beans should be kept in a tight box or bag and any beetles that escape in the bag destroyed.

Throw the infested beans into hot water. (The exact amount of heat that beans will stand and germinate is not known but experiments would determine.) We feel sure the germ will stand more heat than the weevils.

Prof. Weed killed pea weevils by exposing the peas to a temperature of 145° F. for an hour. Bean weevils probably could be destroyed in the same way.

Probably the best way is to put the beans into a tight box and fill it with the vapor of *Bisulphide of Carbon* and leave it for two or three days. Bisulphide of Carbon is *very inflamable* and no light should be brought near it.

Experiments show that infested beans lack in vitality and when good seed can be had it is best to procure it and not run the risk of perpetuating the pest and growing a crop of weakened plants.

The Pear-Blight Beetle, or Shot-Borer.

Xyleborus pyri, Peck=X. dispar, Fbr.

Order Coleoptera: Family Scolytidæ.

Last summer we received some small apple tree limbs from Professor Munson for examination. They were handed to him by Mr J. N. Allen, North Sedgwick, Me. We obtained the same insect from Dr. Twitchell about the same time from the vicinity of Augusta. These limbs were literally honey-combed with small channels that extended through the liburnum and heart wood to the centre. The exit holes through the bark were .06 to .08 of an inch in diameter and nearly circular, looking like small shot holes. The wood was green showing that the insect attacks the growing tree. Living wood does not appear to be essential to the life and comfort of this species, for after a period of several weeks we found in a limb that had been in a dry place in a box, young larvæ, full grown larvæ, pupæ and perfect beetles. We put a portion of a small limb (2 inches by 3 inches) in a box and allowed the pupæ to transform and in the fall we found fifty beetles had emerged.

We wrote a short account of this insect at the time for the *Maine Farmer* and called it *Xyleborus pyri*, Peck, the Pear-blight Beetle. To be absolutely certain we sent some specimens to Mr. A. H. Hopkins, Morgantown, West Virginia, who has given special attention to the *Scolytids* and he sent the following reply:

"The beetle you sent is *Xyleborus pyri*, Peck=*X. dispar*, Fbr. This species is quite common in West Virginia, but strange to say, I have never met with it in apple or pear trees. I find it in hemlock, beech, birch and oak. I have specimens of X. dispar from

Germany and though I can detect a slight difference between the females of the European and American form yet there is not difference enough to separate them as distinct species." We have seen this beetle in abundance in juniper about Orono and we have no doubt that it has transferred its depredations from adjacent forest to the orchards. Professor Fletcher reports its increase in Nova Scotia.

Below we give a description, the life history and suggestions for the treatment of this beetle.

DESCRIPTION.

So far as we know the eggs have not been described. They must be very small and are said to be laid at the base of the buds. We have never seen them The young larvæ bore into the wood making deep channels which in small twigs interfere with the circulation of the sap, and the twigs wither giving the appearance of blight, hence the name PEAR-BLIGHT BEETLE. The work of this beetle should not be confounded with the Pear-blight proper which is caused by a species of bacteria. When the larvæ are full grown they transform to pupæ in the burrows and finally emerge as small beetles about one-tenth of an inch long and of a dark brown or nearly black color, with the antennæ and legs of a rusty red. The thorax is short, very convex, rounded and roughened. The wing covers are marked by longitudinal rows of punctures. The hind part of the body slopes abruptly. The beetle natural size and enlarged are shown in Fig. 17. The beetles leave their burrows in July and deposit eggs before August.

FIG. 17. Pear-blight beetle. Natural size and enlarged.

REMEDIES.

As these beetles work wholly under the bark they cannot be reached by insecticides. The only way is to watch the trees during the latter part of June and July and if blighted twigs or diseased limbs are noticed examine the branches for small pin holes and if found the presence of this or some related species may be suspected. The diseased limb should be cut *at once* below the injury far enough to include all the burrows, and *burned*, for the beetles will transform, emerge and attack new trees. As these beetles live in forest trees orchards near timber would be more likely to become infested.

Carrot Fly—Carrot Rust Fly.

Psila rosæ, Fab.

Order Diptera:

We received the following letter from Mr. Morrell which was accompanied by the *larvæ* and pupæ of a species of fly, also pieces of carrot in which the maggots had been working.

"Pittsfield, Maine, April 6, 1893.

Professor F. L. Harvey:

Dear Sir—I send little worms which I would like to have you identify. The worms are in our carrots and have made holes all through them, after the manner of those in the piece I send. The carrots were placed in a barrel and the barrel filled up with fine dry sand like that I send. On sifting the sand I find it full of worms. Beets grown side by side with the carrots, and packed in the same kind of sand have no worms. Very truly,

C. H. Morrell"

Not recognizing the species we wrote Mr. Morrell that the specimens were the larval and pupal stages of a fly that we would have to transform and obtain the flies before identifying it. The infested material being only a barrel of sand and this very fine we suggested sifting it to remove the pupæ and larvæ that had left the carrots to transform and burning the siftings; or heat the whole material with hot water. We received the following reply accompanied with fully *two hundred* pupæ and larvæ.

"Pittsfield, Maine, April 11, 1893.

Dear Sir—Your card received. For the information, thanks. I have sifted part of the sand and burnt the siftings, and put the rest in boiling water. I don't believe those insects will do any more harm. I send another box of them as you requested.

Very truly,

C. H. Morrell."

After having reared the flies we wrote Mr. Morrell as follows:

"Orono, Maine, May 26, 1893.

Mr. C. H. Morrell:

Dear Sir—I have reared the flies from the pupæ and larvæ, which were affecting your carrots, and am now able to state that it is the "Rust Fly" or "Carrot Fly" an *imported* species from *England*, which has been giving some trouble since 1886 in Canada but

so far as I know has *never* before been reported from the United States. It is regarded as a very troublesome insect abroad and its introduction here is certainly unfortunate. I am at a loss to suggest how it reached your locality, and will be pleased if you can give me any help in the matter. Have you noticed it before in your place? Please ascertain whether your neighbors have noticed it. Have carrots been imported to your locality, if so, from where? You better watch your carrot bed this season and if the leaves of the young plants turn brown, examine the young roots for the brown rust spots on the surface and the interior for the maggots. If you find them, then after thinning, sift sand saturated with kerosene between the rows, and water heavily to pack the dirt close to the roots so the flies cannot crawl down to lay their eggs.

Respectfully, F. L. Harvey."

We put the larvæ and pupæ sent by Mr. Morrell into sand in a breeding cage and in about two weeks the flies began to emerge in abundance and continued to come out for two weeks. We transferred some males and females to a jar containing parsnips, as we were not able to get carrots. In a day or two we noticed the females crawling between the leaves and going down to the base of them and though we had not observed them mating presumed they were ovipositing. The next day we broke off a leaf and found the eggs near the base laid on the surface in small clusters and loosely attached to the surface of the leaf. Having now eggs, larvæ, pupæ and flies we made out the following description:

Eggs—.6 mm. long (.024 in.) by .115 mm. broad (.0046 in.) white, oblong, about five times as long as broad, longitudinally marked from end to end by about 10 ridges and furrows which are from centre to centre .022 mm. The furrows between the ridges are marked by about thirty circular pits. The sculpture resembles the surface of a peanut. At one end the egg abruptly narrows and bears an oblong pedicil, twice as broad as long, and one-third the width of the egg at the widest part, (.022 mm. x .044 mm.) The pedicilate end of the egg reminds one of a tied grain sack. See Fig. 18.

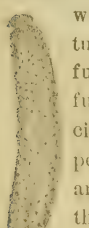


Fig. 18. Egg of Psila rosæ × 50 times. (Original.)

Larvæ—6 mm. long, (.25 in.) breadth 1 mm., (.04 in.) legless, white or pale yellow, semi-transparent, head end quite pointed and armed with a pair of black hooks for gnawing. Aboral end

blunt, obliquely docked and bearing on the face of the oblique portion the dark colored caudal spiracles. Third segment from the last longest and somewhat longer than the last two. The sutures between the segment deep. The segments somewhat transversely wrinkled. See Fig. 19.

Fig. 19. Psila rosæ. Larva × 8 times (original.)

Pupæ—5 mm. (.20 in.) long, 1.25 mm. (.05 in.) wide, coarctate, brown, obliquely docked behind. The docked portion bordered by a rim and bearing two black tubercles. Fig. 20 shows dorsal and side views. The form of the pupæ is quite variable. Some have two tubercles at the head end and the black candol spiracles show on the oblique end. Some have the sides parallel while others are quite fusiform. The surface is quite wrinkled. Some are fully a fifth longer than others.

Fig. 20. Psila rosæ. Pupæ × 8 times (original.)

Flies—Length 6 mm. (.25 in.) Wings 3 5 mm. long (14 in.) and extending nearly half their length beyond the abdomen, thin and iridescent. Abdomen and thorax shining pitch black clothed with short grayish pubescence. Head pale orange or yellowish; eyes dark brown; Antennæ basal joint general color of head, terminal joint nearly black, bristles light. A spot above the mouth black, palpi black, proboscis very prominent, oblong and armed with many short hairs. Legs pale yellowish brown. Abdomen ovate. Scutellum raised and bearing two bristles. Arista armed with short hairs. About eight bristles on the mesothorax. The flies have the habit of opening and closing the wings, which are quite iridescent in the sunlight. The males are smaller than the females. Fig. 21 shows the form and veining of the wing. If the veining of the wing s o *Psila rosæ* are correctly shown in the small cut in United States Agricultural Report, 1893, p. 133 then serious doubt arises regarding the determination for the veining of the wings of our specimens are quite different. Probably in so small a cut accuracy was not considered essential.

Fig. 21. Psila rosæ, wing × 10 (original.)

Report of Botanist and Entomologist.*

Prof. F. L. Harvey.

Professor W. H. Jordan:

Dear Sir—I have the honor to submit herewith my seventh annual report as botanist and entomologist for the Experiment Station. The correspondence regarding injurious insects and fungi, weeds, forage plants and seeds increases rapidly each year. It is gratifying to know that the work of the Station is becoming better known and appreciated, and that the Station is able to extend its usefulness in these directions. As but one-third of the writer's time is given to Station work the correspondence is rapidly encroaching upon the hours that possibly could be better employed making investigations in the field and laboratory. We fully realize that extensive and detailed correspondence must of necessity be an important feature of Station work, though it is only by original research that new facts can be added to entomological and botanical science. We do not desire to limit the correspondence, because the specimens received often are most interesting and important objects for investigation.

The duties of the season have been field work, laboratory investigations, lectures, preparation of articles for the State papers and Science Journals, correspondence and the preparation of this report.

By invitation of the Gypsy Moth Commission of Massachusetts, we visited Malden in July and spent three days in the offices, laboratories and field examining the methods used to fight this insect and submitted to the commission a report of our impressions. In September by invitation and courtesy of Mr. McKeen, we spent two days at Fryeburg examining the area infested by the chinch bug.

Investigations in the laboratory during the season have brought to light several species of insects new to entomological science, some new habits of well known insects, and additional information regarding the life histories and distribution of others. Some new

* Papers from the Maine Agricultural Experiment Station. Entomology No. 9.

fungi and weeds have been added to the State flora. Descriptions of some of the new species of insect were contributed to Entomological Journals, as the scope of Station reports is limited to matters of economic importance. We were called twice during the season to lecture before farmers' clubs and also delivered fifteen lectures to the winter students in agriculture upon Injurious Insects and Fungi.

Below will be found tabulated the more important plants and insects that have claimed attention. These tables are presented from year to year, as a record of the most important insects and plants claiming attention and are valuable for reference. Specimens new to the State, or of special importance are considered in detail and illustrated.

The Orange Roestelia has been very abundant the past season in southern and western Maine doing much damage to quince bushes. This fungus is considered in detail in the body of the report.

The Pear-leaf Blight which in our last report we stated was spreading in the vicinity of Portland has appeared this season in the Penobscot valley in the vicinity of Belfast and Northport.

The Pear-twig Blight (*Micrococcus amylovorus*, Burrill,) has also done some damage about Northport.

The Black Knot continues to be reported and will no doubt be prevalent as long as bird cherry, laden with the knots, can be found on nearly every farm in the State.

Inconspicuous Helminthosporium and Common Cladosporium, two fungus parasites, feeding upon the juices of the leaves and stems of oats, have been found to be the cause of their dwarfing and prematurely turning yellow.

The Yellow Rocket or Winter Cress, False Flax or Gold of Pleasure and *Berteroa incana*, DC, all plants of the mustard family (*Cruciferæ*) have been found in the State. The first two quite abundant. The third is mentioned as it is a weed new to the State, introduced in 1893 in clover seed. It is associated with The Ditchotomous Catchfly a weed found in the State the past season for the first time and belonging to the pink family (*Caryophyllaceæ*).

The Canada Thistle has been reported as a weed in meadows. It should be eradicated as quickly as possible.

The Orange Hawkweed as shown by the table, which gives new localities, is spreading rapidly.

The Fall Dandelion *improperly called Arnica* is also spreading.

The Wild Carrot is also increasing. We saw considerable of it last summer in meadows in western Maine. This is a biennial and should be pulled by the roots.

Authemis tinctoria. A relative of the may weed was received from western Maine and reported as quite abundant.

The Flax Dodder, (*Cuscuta epithymum*, Murr.) was found in some abundance in a clover field in Bradley. This parasite on clover, so far as we know, has not been before reported from Maine.

The Common Snow Flea a small blue-black, wingless, jumping insect found on the snow on warm days in spring was received from Mr. McKeen. It sometimes collects on the surface of water or is troublesome by getting into sap tubs. These simple structured insects are believed by entomologists to be the lowest. They are like the earliest insects that were on the earth, the ancesters of the varied and complex forms of the present age.

The Silver Moth (*Lepisma*) was reported from western Maine. This insect belongs to the same order as the snow flea (*Thysanura*) though quite different in habits. It feeds upon starchy and sugary matter and frequents closets and pantries often doing much damage.

The Ring-banded Soldier Bug was found preying upon the larvæ of the potato beetle. It is figured in the body of the report.

The Elm Tree Bark Louse, *Lecanium Caryæ*, Fitch; *Var Canadense*, Cockerell. There is a bark louse of a mahogany brown color and hemispherical shell. It is very abundant upon elm trees all over the State and must do much damage. The branches in spring are sometimes literally alive with the young lice. These remain active all winter and develop the brown hemispherical scales over themselves the following spring. They can be found during the winter months as small oblong reddish brown objects lying close to the bark on the twigs. The leaves in early summer are often alive with them. The eggs are reddish and oblong. The scales are often punctured by parasites, probably a species of ichneumon, also a species of mite is often found under the scales in great numbers. We have had this species under observation every season for the past eight and there is hardly an elm tree in the vicinity of Orono but what is infested. The scales drop off sooner or later exposing a circular wooly patch. We received specimens from Mr. Moore of Presque Isle during the season showing its wide distribution. We sent

specimens to Mr. Cockerell who pronounces it an undescribed variety. Mr. Cockerell has kindly sent us a MSS description which we incorporate in the body of the report.

There has been considerable complaint about an insect that destroys the terminal buds of gooseberry canes causing the growth of numerous small lateral shoots in a cluster near the ends of the branches. The specimens sent us this year and last were not accompanied by any live insects, but as the leaves showed numerous molt skins we concluded it must be the work of *Myzus ribes*, The Gooseberry Plant-Louse.

The Cabbage Butterfly (*Pieris rapæ*) is very abundant in Maine and interferes seriously with the culture of cabbage. There are various subtances that can be applied to check this pest, but none are effectual except *arsenical compounds* applied as spray, or in the form of powder. As arsenic is poisonous it should not be applied after the heads are a third grown.

We receive occasionally a large pale green moth with long tails to the hind wings. This is the Luna Moth, a night flying species, the larvæ of which feeds upon the walnut and hickory and no doubt other plants, as it is rather common about Orono and there are no native walnuts or hickories.

The Oblique-banded Leaf-roller does considerable damage to currants and raspberries and other plants of the Rose family.

We receive the Cecropia Emperor Moth so often that it is regarded best to publish cuts of this conspicuous species which feeds upon the leaves of apple trees.

The Chinch Bug which is found over quite a large area in the vicinity of Fryeburg has done quite a good deal of damage annually to grass lands after haying for a great many years. It is not confined to the intervales about Fryeburg, but it has been reported from Bridgton on the east and from the vicinity of Bethel twenty-five miles to the north.

We received specimens of a Hawk Moth known as (*Smerinthus cerysii*) from Mr. A. N. Townes, Winthrop, Me. This is a rare species and we mention it on this account. The early stages in its life history have never been published. We secured a large number of fertile eggs and have been able to rear the insects and make notes upon all the stages. Prof. Braun of Bangor, and Mr. Ora Knight, one of my pupils, have aided in the study. The notes will be contributed to some Entomological Journal. The species feeds upon the willow and poplar.

The Buffalo Carpet Beetle is doing considerable damage to carpets in southern and western Maine, and has also been reported from Bangor and Belfast. We wrote an article for the Lewiston Journal on this insect, which is published in the body of this report.

The Maple Tree Borer or Beautiful Clytus, a common insect in Maine, was received from Mr. McKeen and found in Augusta, about maple trees.

The Pea Weavel is very common in Maine. We figured this insect in our last report on page 175. This insect can be readily destroyed in stored peas by the use of Bisulphide of Carbon, as recommended for destroying the Bean Weevil in our last report on p. 176.

The Brown Grain Beetle (*Tribolium ferrugineum*, Fab.) was received from *Mr. Edward* of South Paris. The specimens were in middlings which were literally alive with them. It is a brown insect, oblong in form and about one-eighth to three-sixteenths of an inch in length. It frequents neglected grainaries, museums, kitchens and storerooms feeding upon both vegetable and animal matter.

The Oak Bark Beetle (*Magdalis olyra*) was received from Mr. Moore of Presque Isle where it was doing considerable damage to the foliage of elm trees. So far as we know this species has never been reported as an elm tree insect.

Those insects that require more than a passing notice and record are described more fully in the body of the report.

Directions for Sending Specimens

Will be found in the Annual Report of the Experiment Station, 1888, p. 194, or in the Maine Agricultural Report, 1888, p. 158.

Correspondence.

Correspondence regarding injurious insects and fungi is invited. Plants and insects will be named whether injurious, beneficial or neutral. When of economic importance their benefits or injuries will be pointed out and remedies for injuries suggested.

Remarks.

The cuts to illustrate this report were obtained as follows: Fig. 1, loaned by Prof. Halstead; Figs. 7, 8 and 9, from J. B. Lippincott & Co.; Fig. 11, from U. S. Dept. of Agric.; Fig. 5, loaned by Prof. J. B. Smith; Figs. 2, 3, 4, 6 and 12 and Pl. 1, are after drawings made by the writer.

PLANTS REPORTED AND EXAMINED—1894.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Orange Roestelia	*Roestelia aurantiaca*, Peck	M. B. Whiting, East Northport... / John A. Dennett, North Berwick,	Fungous disease upon quince trees affecting the twigs. Very common in southwestern Me. in 1894.
2	Pear Leaf Blight	*Entomosporium maculatum*, Lev	John G. Brooks, Belfast ... / M. B. Whiting, East Northport...	Affecting the leaves of pear trees. For description see Ex. Station Report, 1892, p. 109.
3	Pear Blight	*Micrococcus amylovorus*, Burrell	M. B. Whiting, East Northport	Causing the twigs of pear trees to turn black and the leaves wither. See Me. Ag. Rep't 1889, p. 101 in Pom. Society Report.
4	Apple Scab	*Fusicladium dendriticum*	M. Wiggins, Bridgton	Causing scabby spots on leaves and fruit of apple trees. See Ex. Sta. Rep. 1888, p. 149, '89, p. 182, '90, p. 113
5	Black Knot	*Otthia morbosa* (Schw.), =*Plowrightia morbosa*, Sacc.,	John G. Brooks, Belfast / John B. Holbrook, Peak's Island,	Infesting plum trees causing warty excrescences. See Me. Ag. Rep. 1889, p. 103 (Pom. Soc. Report.)
6	Inconspicuous Helminthosporium	*Helminthosporium inconspicuum*, C. and E., var. *Britanicum*, Grove. (Sacc. Syll. IV, p. 412,	B. Walker McKeen, Augusta .... / Z. A. Gilbert, North Greene ..... / F. L. Harvey, Orono.	Causing oats to turn yellow before maturity.
7	Common Cladosporium	*Cladosporium herbarum* (Pers.), Sacc. Syll. IV, p. 350,	F. L. Harvey, Orono	Causing oats to look sickly and early turn yellow.
8	Yellow Rocket—Winter Cress,	*Barbarea vulgaris*, R. Br	A. M. Piper, East Madison / O. H. Perkins, Sanford	Weed in grass land. Weed in open damp fields.
9	False Flax, or Gold of Pleasure	*Camelina sativa*, Crantz	A. M. Piper, East Madison	Weed in grass land. See Ex. Sta. Report 1889, p. 185.
10		*Berteroa incana*, D. C.	C. H. Gould, North Bridgton, and many others in Western Maine,	Growing in grass land. Introduced in 1893. A bad cruciferous weed.
11	Night Flowering Catchfly	*Silene noctiflora*, L	F. L. Harvey, Orono	Weed on lawns and waste places.
12	The Dichotomous Catchfly	*Silene dichotoma*, Ehrh	From many persons and localities which are mentioned in the body of the Report	Introduced in grass seed in 1893, the weed maturing in '94. New to the State. Introduced from continental Europe.
13	Canadian Hypericum	*Hypericum Canadense*, L	Miss Helen M. Port, Kennebunk	For determination.

14	PURPLE AVENS	*Geum rivale*, L	O. H. Perkins, Sanford	In low meadows. A weed.
15	COMMON EVENING PRIMROSE	*Œnothera biennis*, L	E. B. Lufkin, East Orrington	Rank weed in fields and waste places.
16	SUNDROPS	*Œnothera fruticosa*, L	Stephen Larrabee, Dexter	Weed in grass lands.
17	SWEET SCENTED BED STRAW	*Galium triforum*, Mx	Miss Helen M. Port, Kennebunk	Weed in border of fields and wood land.
18	CANADA THISTLE	*Cnicus arvensis*, Hoffm	A. M. Piper, East Madison	Weed in grass land.
19	SUCCORY, or CHICORY	*Cichorium Intybus*, L	A. M. Piper, East Madison	Weed in grass land.
20	ORANGE HAWKWEED	*Hieracium aurantiacum*, L	F. L. Harvey, Brewer A. M. Lufkin, East Orrington Philip H. Stubbs, Strong Edwin E. Baker, Richmond Cor., Will P. Winslow, Larone	Weed in meadows and grass land. See Experiment Station Report, 1892, p. 106 (illustrated).
21		*Anthemis tinctoria*	C. H. Gould, North Bridgton	Related to the Mayweed. Weed in grass land. Also found in Penobscot Co. about Brewer in 1886.
22	ROUGH HAWKWEED	*Hieracium scabrum*, Mx	Miss Helen M. Port, Kennebunk	Weed in border of fields and open woods.
23	INDIAN PIPE—CORPSE PLANT	*Monotropa uniflora*, L	Mrs. A. M. Garland, South Dover	In pasture lands.
24	CLOVER DODDER	*Cuscuta Epithymum*, Murr	F. L. Harvey, Orono	Clover fields Bradley, Me. New to the State.
25	TURTLE HEAD, SNAKE HEAD	*Chelona glabra*, L	Miss Helen M. Port, Kennebunk	Weed in low meadows.
26	NAKED BROOM RAPE	*Aphylon uniflorum*, Gray	Fred W. Cousins, West Kennebunk,	Moist soil by roadside.
27	MAD-DOG SKULLCAP	*Scutellaria galericulata*, L	E. G. Knights, Waterboro	In low grass land. A weed.
28	CHESS, or CHEAT	*Bromus secalinus*, L	W. H. Keith, Winthrop	Weed in grass land and cultivated fields. See Experiment Station Report, 1891, p. 183 (illustrated).
29	YELLOW, or HOP CLOVER	*Trifolium agrarium*, L	S. H. J. Berry, Wayne	Weed on roadside. Poor for hay.

INSECTS REPORTED AND EXAMINED—1894.

NO.	COMMON NAME.	TECHNICAL NAME.	FROM WHOM RECEIVED.	REMARKS.
1	SNOW FLEA	*Achorutes nivicola*, Fitch	B. Walker McKeen	Abundant in June about the roots of a tree. More often observed upon the snow in warm winter days or in the spring.
2	SILVER MOTH	*Lepisma Saccharina*, L	Mrs. Rose C. Johnson, Gorham,	Very abundant about the pantry. Eating sugar, paste, etc. Also does damage to books and clothing.
3	RING-BANDED SOLDIER BUG	*Perillus circumcinctus*, Stal	Gustavus Pease, Bean's Corner,	Parasite upon the larvæ of potato beetles, piercing the larvæ with the proboscis and sucking out the soft parts.
4	CHINCH BUG	*Blissus leucopterus* Say	F. L. Harvey, Orono	Doing considerable damage to grass lands after haying, and also some damage to corn fields. Over a large area in the intervales about Fryeburg, Bridgton and Bethel, Me.
5	ELM-TREE BARK LOUSE	*Lecanium caryae*, var. *canadense* cockerell	Delano Moore, Presque Isle	Coccid or bark louse. Very common on elms about Orono, Me.
6	THE GOOSEBERRY PLANT LOUSE	*Myzus ribis*, L	Delano Moore, Presque Isle	Causing numerous small twigs to start from lateral buds near the end of the shoots, making a terminal bunch of small twigs and dwarfed leaves.
7	HELLGRAMITE FLY	*Corydalis cornuta*	Geo. M. Pillsbury, Lisbon Falls,	The larva which was received by us is called "Dobson" by anglers, and is used as a bait for bass. It is found in ponds and streams.
8	CABBAGE BUTTERFLY	*Pieris rapae*, L	Wm. J. Higgins, Fairfield.	Infesting cabbage. Lays its eggs upon cabbage, which hatch into cabbage worms.
9	THE LUNA MOTH	*Attacus luna*	B. Walker McKeen	A night-flying species. The larva is said to feed upon the walnut and hickory.
10	OBLIQUE-BANDED LEAF-ROLLER	*Cacoecia rosaceana* (Harris.)	Chas. S. Pope, Manchester	Attacking the leaves of currants and rasp berries, causing them to roll.

11	CECROPIA EMPEROR MOTH	*Platysamia cecropia* (Linn.).....	James Steele, Cherryfield	Cocoons attached to the limb of an apple tree.
12	....	*Smerinthus cerysii*, Kirby	Albion V. Towns, Winthrop....	Found on Bracken Fern. Male and female mating. Food plant, willow and poplar.
13	THE BUFFALO CARPET BEETLE..	*Anthrenus Scrophulariæ*....	Geo. W. Jeffery, North Monmouth, and several other parties in Western Maine.	Destroying carpets, rugs and woolen garments.
14	THE BEAUTIFUL CLYTUS.....	*Clytus speciosus*, Say.	B. Walker McKeen, Augusta...	The larva boring in maple trees.
15	PEA WEAVEL.....	*Bruchus pisi*, L	E. T. Perkins, Saco.....	Doing damage to peas. Causing what are called "Buggy peas."
16	THE BROWN GRAIN BEETLE....	*Tribolium ferrugineum*, Fab	Chas. Edwards, South Paris....	Found in great numbers in middlings.
17	OAK-BARK WEEVIL.	*Magdalis olyra*, (Herbst.).	Delano Moore, Presque Isle...	Eating holes in the leaves of elm trees and hazel bushes. Very abundant.
18	.. ..	*Thalessa lunator*, (Fabr.).....	A. B. Ripley, Augusta	Boring into dead maple trees to lay their eggs. This is the largest of our Ichneumons. The ovipositor, fully two inches long. Parasitic upon the Tremex saw fly.

BOTANY.

THE ORANGE-COLORED ROESTELIA OR QUINCE RUST.

Roestelia aurantiaca, Peck.

Order *Uredineæ*.

The following letters were received during last July, in which were enclosed quince twigs affected by the above fungus.

EAST NORTHPORT, ME., July 25, 1894.

Prof. F. L. Harvey:

DEAR SIR—I enclose a twig from one of my quince bushes, having on it apparently some sort of fungous growth. On some of my bushes this has appeared numerously. It must be very injurious if allowed to grow. Will you please give me your opinion of it? In my limited reading on quince culture I have come across no reference to such a disease. Respectfully,

M. B. WHITING.

We wrote Mr. Whiting regarding the nature of the disease and below is given his interesting reply:

EAST NORTHPORT, ME., July 31, 1894.

Prof. F. L. Harvey:

DEAR SIR—Please accept my thanks for very full description of quince disease contained in yours of 27th inst. I knew of the rust, but was not before aware that it took the form of an excrescence on the twigs. In this case the cause of infection is undoubtedly to be traced to my cedar hedge, which extends in front of house, the quince is growing behind the house and separated from the hedge by it. The quince bushes are young, having been set only last year. The fungus did not appear until this season. The cedar, however, has no fungus on it, and its foliage is almost entirely free from rust or those dead, discolored twigs, which I presume is rust. I think it may be, as you suggest, that my quinces were already affected when I received them, as most of the Geneva, New York, nurseries, whence they came, grow arbor vitæ. I had intended to go quite extensively into quince culture, as I think, barring disease, it could be made a success here; but unless I can prevent the rust of course it will be useless for me to attempt it.

Do you think that the Bordeaux mixture would prove effectual, both to cedar and quince? I do not wish to remove my hedge.

Respectfully,

M. B. WHITING.

We also received through Hon. B. Walker McKeen specimens of this same disease accompanied by the following letter from Mr. Dennett.

NORTH BERWICK, ME., July 15, 1894.

MR. SECRETARY—Inclosed I send for your inspection, a growth I find upon three quince trees, I bought from New York nurseries, and set last spring. One each of three varieties, Fuller, Alaska and Meech Prolific. They have started finely, but upon almost every twig there is a growth of this kind. I do not understand it, for it has never appeared on our Orange and Champions that we have had growing for years. Do you think it is anything like the black knot of plum trees that should be destroyed to prevent it from spreading? The trees have started thriftily, but it looks as though this would work their destruction. Can you please tell me what should or can be done with them? I dislike to destroy them unless it shall be necessary.

Very truly yours,

JOHN A. DENNETT.

In answer to some questions regarding the occurrence of cedar trees near Mr. Dennett's orchard we received the following, which strengthens the belief that the nursery stock was infected.

NORTH BERWICK, ME., February 5, 1895.

Prof. F. L. Harvey:

DEAR SIR—In answer to your esteemed note of 29th ult., will say that we have no cedar growth in this vicinity within miles of us, neither do I know of any cedar ornamental growth or hedges about here. The unaffected Orange and Champion were older trees which had been set several seasons, this fungus attacked the new set quince that I had from New York and New Jersey nurseries, (Green's and Lovett's,) hardly a twig of which escaped. I took the precaution to cut off and burn all the fungous growth and if it should appear again this season I will report to you, as it was entirely new to me and of which I am entirely unacquainted.

Very truly yours,

JOHN A. DENNETT.

As this fungus has been very abundant in southern and southwestern Maine during the past season, and is almost sure to appear again, we give for the benefit of all concerned the following account of the disease:

NATURE AND DISTRIBUTION.

This fungus has two stages in its life history, which are found upon very different plants. The *Gymnosporangium* or Cedar Apple stage, which occurs upon the Red Cedar and Low Juniper, members of the Order Coniferæ, and is known as *Gymnosporangium clavipes*, C & P. The *Rœstelia* or Rust stage (known as *Rœstelia aurantiaca*, Peck.) which occurs upon the Sugar Pear, (Amelanchier) Pear thorns (Cratægus), Choke Berry (Pyrus arbutifolia) and the cultivated quince and apple trees, all plants belonging to the Order Rosaceæ.

The first stage of the disease is probably as widely distributed as cedar trees and has been detected throughout the New England, Middle and most of the seaboard Southern States.

This stage of the disease is the *forerunner* of the *Rœstelia* or *Rust* stage, which cannot occur without it. The Red Cedar and Low Juniper are, therefore, responsible for the occurrence of the Rœstelia or Rust upon quince and apple trees. After the *Rœstelia* has become established in quince and apple trees it is *probably perennial*, that is, the mycelium may live in the twigs and produce spores from year to year.

The spores produced by the Rœstelia upon plants of the Order Rosaceæ can only grow when they find lodgment under proper conditions upon cedar trees, and then they produce the *gymnosporangium* stage or cedar apples.

The mycelium of the gymnosporangium is abundant causing the twigs of cedar trees to become swollen and much branched and the leaves to swell to double their natural size and become pointed and spreading. This is well shown in Fig. 1, A, which represents a diseased branch with enlarged and pointed leaves and bearing the reddish or brownish sporiferous masses. Fig. 1, B, shows a normal branch and Fig. 1, C, one of the ovate, two-celled spores which is germinating.

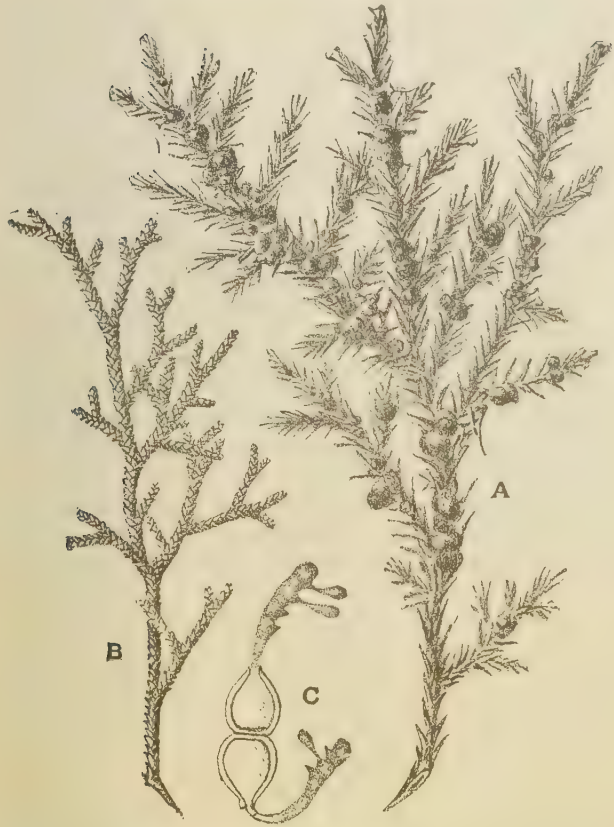


FIG. 1. A—Diseased cedar twig. B—Normal twig. C—Germinating spore.

At a distance this disease gives the appearance of birds' nests in the boughs. It is believed to be perennial.

The *Rœstelia* makes its appearance upon the young fruit and twigs of quince trees and other rosaceous plants early in the summer. It first sends its threads through the host producing orange spots in which pimples appear. From the top of these pimples short shining white horns (Peridia) are developed which are coarsely toothed at the top and contain the bright orange spores.

FIG. 2. Quince twig affected by Roestelia. a—Spore enlarged (original).

Fig. 2. shows a quince twig affected by the fungus; Fig. 2, A, one of its spores enlarged.

The leaves of the specimens received were also affected by another species of *Gymnosporangium* (G. *lacerta*) which had passed its prime. Those of *Roestelia aurantiaca*, Peck, were in their prime when received in July.

REMEDIES.

1. As this fungus is perennial upon cedar trees it could not be killed by spraying with Bordeaux mixture. Possibly if sprayed at the time the spores were ripening they might be killed and prevented from being blown to quince and apple trees. This would be practical only upon hedges and ornamental trees. It would not be practical to spray forest trees. The rust stage of this disease is an *internal parasite* and has done its worst work when the orange patches and excrescences appear on quince and apple twigs, fruit or leaves. It would do the quince or apple trees no good to spray at that time. To spray early in spring when the spores from cedar trees are floating in the air would suggest itself as a preventive measure. To spray when the Roestelia spores are ripe would probably destroy them and prevent the infection of cedar trees. There have been no spraying experiments tried with this disease so far as we know.

2. As the galls on cedar trees furnish the spores of this disease, all cedar trees in the vicinity of the orchard should be destroyed if possible. This would greatly lessen the chances of infection but

would not entirely remove the danger, as spores of fungi are sometimes carried long distances We have seen this rust upon sugar pear (Amelanchier) where there were no cedar trees nearer than a half mile, and they could be carried much farther.

3. It is probable that this rust is *perennial* upon quince and apple trees. The disease might, therefore, be introduced upon affected nursery stock and be very bad the first season after the trees are set. The experience of Mr. Dennett could be explained upon the basis that the Fuller, Alaska and Meech Prolific were affected when they came from the nursery, while the Orange and Champions escaped because there was no local cause of infection. If this supposition is correct the disease ought to disappear next season if the fungus is annual, or continue and not spread if perennial. It is the belief that *Roestelia* spores will not spread the disease to other quince and apple trees. We will be much interested in the developments at Mr. Dennett's. There have been no carefully conducted experiments to prove whether the *Roestelia* stage of this disease is *perennial* nor so far as we know to show *conclusively* that *Roestelia* spores (æcidiospores) may not produce *Roestelia* directly. Carefully conducted experiments are needed to settle these points.

4. It would be well to cut and burn the twigs bearing excrescences before the spores are liberated, and also to destroy all affected fruit.

DISEASES OF OATS.

Helminthosporium Inconspicuum, C. & E. *Var. Britanicum*, Grove.

During the summer of 1893 we received through Mr. Z. A. Gilbert specimens of oat plants which had turned prematurely yellow. We were informed that this condition was common in certain portions of the State. As we were unable to find any fungus at work we concluded *as the season was wet* that it was probably a case of malnutrition due to poor drainage and excess of moisture. This season the complaint was renewed by Mr. McKeen. The specimens he sent were found to be badly infested by a species of *Helminthosporium* which we submitted to Mr. J. B. Ellis who decided that it was the species named at the head of this article. It is described in Saccardo's Sylloge IV, p. 412. The type form

of this species is reported from New Jersey and New York, upon living and languishing leaves of *Zea Maydis*. The variety is reported from Warwickshire England and so far as we know has not been reported before from the United States. The conidia of our specimens were 40—80x15 m m and 1—5 septate. See Fig. 3. Saccardo gives the dimensions 60—100x12x22 m m and 4—5 septate. The spores of our specimens are somewhat shorter and sometimes with less septa. This fungus is no doubt truly parasitic and capable of producing the languishing condition of the oat plants. In the specimens sent by Mr. Gilbert the disease had not progressed far enough to show the spore, masses which were dark brown colored and appeared as small dark dots or lines upon the leaves sent by Mr. McKeen.

Specimens taken from an oat field upon the college grounds that appeared to be similarly affected yielded, upon examination, another fungus known as

Cladosporium herbarorum (Pers.)

Fig. 3.

Original. Fig. 4.

The conidia of this species are 6—20×5—7 mm and without septa or 2—3 septate. This species is almost world-wide in distribution and attacks members of several botanical families. It is described in Saccardo's Sylloge IV, p. 350. The spores are shown much enlarged in Fig. 4.

The languishing of oat plants in Maine is, therefore, due to the combined action of the two parasites named above. As they are both *internal parasites* we know of no remedy for them. They would probably be much worse in wet. warm seasons and on low land.

NIGHT-FLOWERING CATCHFLY.

Silene noctiflora. L.

ORDER CARYOPHYLLACEÆ: PINK FAMILY.

This species of catchfly occurs sparingly in Maine in cultivated and waste grounds and roadsides. We found quite a number of specimens the past season upon lawns and waste ground in Orono, probably introduced in grass seed.

It is a coarse plant from three inches to three feet high, with viscid, pubescent leaves. The lower leaves spatulate; the upper lanceolate and pointed. Short, leafy branches, often from the axils of the opposite leaves. Flowers in loose cymes, pedicilate, and usually bearing a single flower, though sometimes more. The central flower of the inflorescence opening first

Calyx large after flowering becoming ovoid, greenish white with ten dark green nerves tending to anastomose, the teeth attenuate. Petals creamy white, often with a tinge of pink, bifid. Flowers about one-half inch across, bearing a ten-toothed crown, closing in the bright sunshine, but open in the shade and on cloudy days. Fragrant. Plant annual, though seeds from the early flowering ones soon sprout, and, we think, often blossom and seed before fall. The plate on the opposite page shows a plant reduced about one-fifth. (*a*) Cross section of flower. (*b*) Portion $\frac{3}{2}$ of calyx showing the anastomosing veins. (*c*) A mature capsule with the calyx removed showing dehiscence.

NIGHT FLOWERING CATCHFLY—*Silene noctiflora*, L. (Original.)

THE DICHOTOMOUS CATCHFLY.

Silene dichotoma, Ehrb.

ORDER CARYOPHYLLACEÆ: PINK FAMILY.

During the past season we have received specimens of the above catchfly from the following localities:

NAME.	ADDRESS.	KIND OF SEED SOWN.
D. B. Johnson	Freedom, Me.	Clover, red top and herdsgrass.
Gustave Bellows	Freedom, Me.	Clover, red top and herdsgrass.
Daniel Hustus	Freedom, Me.	Clover, red top and herdsgrass.
Frank Johnson	Freedom, Me.	Clover, red top and herdsgrass.
Stephen Larabee	Dexter, Me.	Red clover, alsike, herdsgrass.
B. W. Mitchell	Dexter, Me.	Red clover, alsike, herdsgrass.
Horace S. Martin	Buxton Center, Me.	Red clover, alsike, herdsgrass.
E. E. Light	Union, Me.	Red clover, red top, herdsgrass.
Nelson W. Adams	Turner Center, Me.	Red clover, red top, herdsgrass.
C. H. Gould	North Bridgton, Me.	Red clover, red top, herdsgrass.

We also learn that this weed has been found at Farmington (C. H. Knowlton), East Livermore (Kate Furbish), Hartford and North Berwick (J. C. Parlin), and York (E. P. Bicknell)

The above shows that this weed is widely introduced in Maine. We examined one lot of seed in 1893 that contained over a dozen bad weed seeds and among them the seeds of this catchfly. We condemned the seed. If wholesale dealers who import from other states or countries would receive samples and have them examined before purchasing and each wholesale dealer was required by state law to submit samples to a state inspector before retailing, the introduction of so many bad weeds could be averted. There were at least four bad weeds introduced in the State in 1893-4. It is to the interest of dealers to offer pure seed and they will probably not knowingly sell poor seed. To secure the selection of good seed the Station botanist will aid dealers and purchasers by inspecting samples submitted. From the record given above it will be seen that only one party sowed alsike and that one party who did not sow redtop had the weed, and that all who had the weed sowed

herdsgrass and clover. The weed was therefore introduced either with herdsgrass or clover. As the seed of this catchfly is much larger than herdsgrass, darker colored, different shaped and with a rough surface, it would be easily detected in herdsgrass, while in clover seed it would probably escape detection by the casual observer. It was probably introduced with clover. The seed has been traced directly or indirectly to a single wholesale establishment. The seed was sold in 1893 and two years has elapsed and the dealer has no samples left and cannot tell where the seed was purchased, so it is impossible to trace it outside the State.

This weed was introduced in seed sown in 1893. It germinated that season, lived over winter and bloomed in 1894. After the grass was cut in 1893 the young plants of this weed were abundant proving it to be a winter annual or biennial. The following letter from Mr. Adams gives the facts regarding the introduction of the weed which are confirmed by the other correspondents:

TURNER CENTER, MAINE, July 4, 1894.

Prof. F. L. Harvey:

DEAR SIR—Last year I purchased enough grass seed to seed down an acre and three-fourths. The seed was a mixture of timothy, redtop and clover and was sown with barley on one piece, and with hungarian grass on another. After the grain and grass were removed in the autumn, I saw a great number of plants growing with the young grass and I thought they were oxeye daisies, judging by the form of the leaf, but when it headed and blossomed I found it was something entirely new to me and to every one to whom I have shown it.

I took a plant to Mr. Lyman Abbott, the agricultural editor of the Lewiston Journal. He didn't know what it was and never saw anything like it before. To-day I saw Mr. Z. A. Gilbert and was talking to him about it, and he said if I would send a stalk of the plant to you, I could find what it was and all there was to learn about it. I have seen fourteen or more stalks growing from one root, and the plants on the entire field are as near together as one on every square yard and on much of it as near as one on every square foot; now I am anxious to know if it will spring up from the root after it is cut this year, and if it is a plant that cattle will eat after it is cut and cured as hay, and if they will eat it, if it is healthful or injurious in case they will eat it.

If you can give information on this subject, you will not only oblige me, but a great number besides myself who are engaged in the same business. I am very respectfully yours,

NELSON W. ADAMS.

DESCRIPTION.

This species of catchfly introduced from Europe, is closely related to the *Night Flowering Catchfly* already described. It may be known by the followig description:

Tall, two to four feet high, more or less clothed with hairs, often reddish and viscid. Probably winter annual or biennial, often over *fifteen* stems from a single root and dichotomously branching toward the top where they bear the one-sided racemose inflorescence. Leaves lanceolate or oblanceolate, those at the base of the flowers near the ends of the branches, small, reddish, three nerved, scarious margined and about half the length of the flowers. Flowers short, pediciled, or nearly sessile, about five-sixteenth inches long; calyx, cylindric in flowering, becoming ovoid in fruit, the ten *bright green nerves* which run from the base to the tips of the lobes strongly hirsute along the back and with *no anastomosing veins*. Diameter of flowers one-half inch, petals white or roseate, obovate, deeply bifid and bearing at the base a two lobed scale which with the others form a crown.

The beautiful seed broadly kidney shaped, light brown, 1.33 mm. $\times$ 1.06 mm. Its surface densely covered with elevations arranged concentric and radiate from the hilum. Those near the hilum narrow, smaller, darker, smooth, bordered and unmarked. Outward from the hilum the papillæ become larger, more conical, oblong, bordered by from 10 to 20 teeth and bearing at the summit a round black dot. The teeth of the contiguous papillæ often interlock.

This species can be told from the other catchfly which we figure by its numerous stalks from the same root, its greater height and more slender growth, dichotomous racemose inflorescence, nearly sessile flowers and the veins of the calyx, which do not have branches running across from one to the other.

TREATMENT.

This plant is a winter annual or biennial. The seed sown in 1893 sprouted that year and the young plants lived over winter and after producing flowers and seed in 1894 died *root* and *branch*.

Of course the best way would be to have seed inspected and reject all that contained the seeds of bad weeds. As this is not practical at present, farmers will be compelled to sow such seed as is offered to them and fight the weed pests that appear. With this particular one nothing could be done the first season. If the plants are prevented from seeding the second season that is the end of them. Some have gone to the trouble of pulling the plants up by the roots, believing the roots to be perennial. This was unnecessary, but the tops should be cut to prevent re-seeding.

Some of the specimens received about the first of August were fully seeded and the seed capsules open. If cut in that condition many of the seeds would be scattered. The plant should be cut as soon as the flowers begin to appear or before. The plant stools badly and each stalk bears several flowers and each capsule has numerous seeds. A few scattering plants would, if neglected, seed a field abundantly. We have had no experience, but doubt whether this weed would make hay. Those who have neglected to cut this weed carefully or have cut after the seed were ripe may expect to see it next season.

POTATO SCAB.

Botanists are agreed that this disease of the potato is caused by a fungus parasite, *Oospora scabies*, Thaxter. That the germs of a fungus will retain their vitality in the soil for several years.

That seed free from the disease will produce a scabby crop if planted upon soil contaminated with the germs.

That scabby seed planted upon soil free from the disease will produce a scabby crop.

That probably the disease is modified by the moisture, fertility, composition and mechanical conditions of the soil.

The source of the disease would therefore be either the *soil* or the *seed*. Conditions could never cause the disease; the germs must be present either in the seed or in the soil. To prevent contamination from the soil potatoes or beets should be grown upon *new* land, that has never grown potatoes, or if upon old soil, that which has not grown potatoes for a number of years. To prevent contamination from seed it should be selected from a field known to have been free from the scab.

If the origin of the seed cannot be determined then select the tubers that appear free from the disease, and soak them for an

hour and a half in a solution of corrosive sublimate or Bordeaux mixture, to kill any germs present.

EXPERIMENT.

To test the efficacy of treating the seed with corrosive sublimate we took some potatoes that were slightly scabby and divided in two lots, one of which was treated two hours in a solution of 2 ounces to 16 gallons of water, and the other not. A portion of the untreated seed was planted, adjoining on each side of the treated. All was fertilized and cultivated the same. The soil had not grown potatoes for four years

The untreated seed came up before the treated and the tops appeared more vigorous during the whole season and obtained a fourth greater growth, and the weight of tubers was much more. All the potatoes were about equally scabby.

CONCLUSIONS.

1. That the germs of potato scab will retain their vitality in the soil for at least four years, as shown.

That if the germs are in the soil the treatment of the tubers with corrosive sublimate will not prevent the disease, and is apparently of no advantage.

That corrosive sublimate has a poisonous effect upon potato plants, depressing their vigor and lessening the yield, when the tubers are treated for two hours. (Our observations agree with those of Professor Taft, who says (Mich. Expt. Sta. Bull. No. 108) that treatment for longer than one and a half hours lessens the amount of scab but reduces the yield.

The only advantage then in the use of corrosive sublimate solution is when suspicious seed is to be planted upon uncontaminated soil.

FORMULA.

Dissolve two ounces of corrosive sublimate in two gallons of hot water and then add fourteen gallons more before using. *Remember that corrosive sublimate will corrode any metal vessel and a wooden receptacle should be used.*

Soak the seed in this solution for one and a half hours, dry, and it is ready to plant.

ENTOMOLOGY.

THE SNOW FLEA.

Achorutes nivicola, Fitch.

ORDER THYSANURA: FAM. PODURIDÆ.

Specimens of the above insect were received from B. Walker McKeen June 13, 1894.

This is the *blue black* insect found in such great numbers upon snow on warm winter days, and also at various seasons upon the surface of pools. They often congregate by the thousands upon tree trunks near the base. Those sent by Mr. McKeen were found near the base of an elm tree. These insects *hybernate* in grass about the base of trees and elsewhere, and about the bark of trees. On warm days in winter they come out. The name *Snow Flea* is usually applied to the above species though we have found four other species at Orono during the winter months upon snow. These and related insects are known by the name of *spring tails* because by means of a forked appendage attached to the abdomen they are able to execute leaps. The color is blue black or dark lead color, and the size from one-tenth to one-fifteenth of an inch.

THE SILVER FISH.

Lepisma saccharina, L.

ORDER THYSANURA: FAM. LEPISMIDÆ.

We received the following letter from Mrs. Johnson, accompanied by specimens which proved to be the above species.

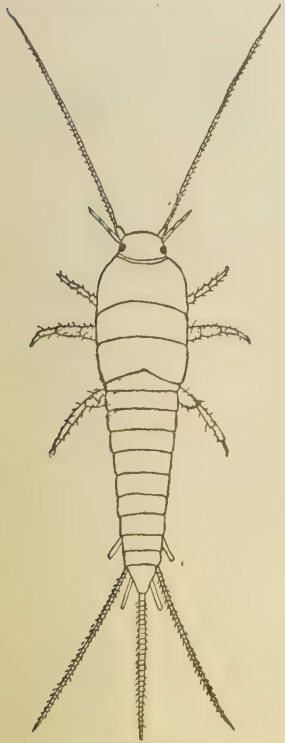


FIG. 5.

GORHAM, Me., Aug. 24, 1894.

F. L. HARVEY.

Dear Sir:—I have sent you three specimens of a bug (?) that has been troubling me this year. Some time in May a beetle, similar in shape to the illustration of the carpet beetle in this week's Lewiston Journal, appeared in the dish closets and on food when it was left exposed. In color it was a silvery gray. It was about a third of an inch in length. About the first of June they disappeared but soon after came in the form of the specimens which I have sent you. These are in everything — dishes, food, clothes, shoes, etc., but I have failed to find any real mischief which they have done.

Please write me what they are.

The buffalo bug is in at least one house in Gorham.

Yours truly,

ROSE C. JOHNSON.

The species of beetle spoken of was probably the common Meat Beetle, *Dermestes lardarius*.

This species may be recognized by the accompanying cut. The insect is of a uniformly dull silvery color, excepting the feet and antennæ, which are pale yellow. The size is about one-third of an inch. Mrs. Johnson has given the habits correctly. "They are in every thing." They are capable of doing considerable damage in libraries and wardrobes, by eating the paste from books, and holes in fabrics. They are very active. As these insects are fond of

starchy or sugary substances, they could be destroyed by poisoned sweets.

This same species has also been reported from Brewer, Me.

THE RING-BANDED SOLDIER-BUG.

Perillus circumcinctus, Stäl.

Order Hemiptera. Family Scutelleridæ.

We received through Mr. McKeen the following letter accompanied by a specimen of the above well-known parasite upon potato beetles:

Bean's Corner, Me., August 6, 1894.

Hon. B. W. McKeen, Augusta, Me.:

Sir—I send you herewith a bug that seems to like to stick his proboscis into the larvæ of the potato beetle and lie back and enjoy life as long as there is anything left in the larvæ. I presume you are acquainted with him, but he is a stranger to me. They do not seem to be numerous at present. Perhaps you would give his life history in one of your bulletins.

Yours resp'y,

Gustave Pease.

This is the first time this insect has been reported to the Station, and as we have not observed it in the State, it is desirable that it be known and protected as a friend to the potato grower. It is a beautiful insect and is sure to attract attention. It may be known by the following description.

Fig. 6. (Original.)

Length about one-half inch, width about one-fifth inch. Polished dark brown marked with cream colored bands as shown in the figure. The thorax and scutellum are coarsely punctured.

Head brown above and yellow beneath, mouth parts brown, antennæ five jointed, darker toward the ends, eyes black and prominent, proboscis four jointed, the terminal two black and also the base of the other two on the *under* side.

Thorax arched, polished brown, darker toward the head, bordered above on the sides and in front by a cream colored band which also extends down the middle of the thorax. The *pro thorax*,

below, narrowly bordered with cream color and a narrow line of the same color down the middle mesathorax below, with a narrow yellow curved line in front of the second legs and down the center.

Scutellum bordered by a cream colored band.

Wings.—The hard portion bordered laterally by a cream colored band.

Abdomen bordered by a yellow brown band and down the center below a row of four blotches of the same color. The general color below, brown, legs brown, the tarse nearly black. The tibia on all the legs encircled in the middle by a band of yellow.

The mature insect enlarged about one-half is shown in Fig 6.

THE ELM TREE BARK LOUSE.

Lecanium Caryæ, Fitch, var. *Canadense*, n. var.

ORDER HEMIPTERA: FAMILY COCCIDÆ.

Extract from a paper, by I. D. A. Cockerell, about to be published in the "Canadian Entomologist:"

Scale smooth, shiny, red-brown, convex, malleate but not or hardly plicate. Length 4, breadth 3, height 2 m m., varying to length 5, breadth 4, height 3 m m. (Some Maine specimens 6 m m. long.) Removed from the twigs, the scales leave an oval white mark. (Nappan scales are paler and more yellowish, also somewhat smaller. Posterior incision perhaps a little longer; scales also rather more tending to be plicate.) Male scale ordinary, rugulose.

With 6 jointed antennæ, formula 326154. 3 considerably larger than the remaining joints put together, 1 with 2 hairs; 2 with 2 hairs at its end, one especially long; 3 with 2 hairs near its end, last joint with several hairs, one especially long. (Nappan antennæ practically the same, but 1 larger; 4 and 5 each show a hair, 6 hardly so long, formula 3(126)54. Maine antennæ show one long hair at end of 3, 2 with 1 very long hair, 2 a little longer than 4, 4 a very little longer than 5, 6 a little longer than 2; formula 36245.) Derm obscurely tessellated, with large gland-pits. (In Maine specimens gland pits frequently in pairs.)

Femur not much larger than tibia. Tarsus hardly 1-3 shorter than tibia; distinctly swollen at base. Claw rather stout, curved at its

tip like a falcon's beak. Digitules of tarsus apparently wanting (deciduous?) Digitules of claw large and distinct, extending well beyond tip of claw, stem moderately stout, knot large and oval. A bristle on end of coxa, one on end of femur and one on end of tibia. (Nappan scales show legs much the same, but femur proportionately longer, tarsus only a little swollen at base; tarsal digitules well developed, long, ordinary; digitules of claw short, not extending to end of claw; claw stout, nearly straight not hooked. Maine examples show coka stout, broader at base than its length, with a hair at its tip; trochanter with a long hair; femur longer than tibia, tarsus about 1 3 shorter than tibia; digitules all filiform.)

Eggs.—(Maine specimens) very pale pinkish.

Hab.—The types are from Stittsville, about 20 miles from Ottawa, Ontario, on *Ulmus racemosa*, sent by Mr. Fletcher. Other specimens are from Nappan, Nova Scotia, on elm (Fletcher) and Orono, Maine, on elm (Harvey). Prof. F. L. Harvey states that it is very abundant at Orono; he has known it for 8 years, and it is increasing. The branches are often almost covered with them.

The Stittsville examples are affected by a coccinellid and by an Encyrtid parasite, perhaps a *Chiloneuras*.

The species is quite different from the European *Lecanium vlmi*, and is doubtless a native of this country. It illustrates well the extreme difficulty of dealing with the American species of *Lecanium;* which have,perhaps, not succeeded in reaching a condition of specific equilibrium since the new developments, which doubtless followed the termination of the glacial epoch. It will be seen from the above, that the characters given are quite variable, unless we are dealing with three species instead of one—a view which I cannot for a moment entertain. While thus convinced that all these elm forms are strictly one thing, I have a very lively conviction that *L.ribis*, Fitch, is different—a conviction which I feel sure would be shared by any one who had seen quantities of both—yet it is difficult to point out the precise nature of the difference, apart from the smaller size of *ribis*. Two species of Fitch, *L. Cynosbati* and *L. Caryæ* have been re-described by Signoret, who shows that they have 6-jointed antennæ like *ribis* and *Canadense*. I have not seen authentic examples of either, but the description of *L. Caryæ* agrees so nearly with our elm species that I place the latter under it as a variety."

The above description refers to the bark-louse found so abundantly upon the elms in Maine and referred to in the introduction as The Elm Tree Bark-louse, which Mr. Cockerell describes as a *new variety*.

THE GOOSEBERRY PLANT-LOUSE.

Myzus ribis, L

ORDER HEMIPTERA: FAMILY APHIDÆ.

We have received from Mr. Delano Moore and other parties during the last three years, specimens of gooseberry twigs, in which the leaves at the end of the branches had been killed, resulting in the development of several short sub-terminal shoots, making a terminal dense cluster of short branches and small leaves. Careful examination of several specimens did not reveal any insect at work, nor could we find any evidence that the main shoot had been infested by either insect or fungous parasites. There were present in several specimens the moult skins of a species of aphis or plant-louse, which we presumed had to do with the injury

The species mentioned above is known to infest currant and gooseberry bushes, causing the leaves to curl and blister, and though we were not able to identify the species from the molt skins, suspect it is responsible for the injuries.

To secure the insects for examination it will be necessary to search for them earlier in the season. The attention of those who have been troubled by these *terminal growths* on gooseberry bushes, is called to the matter. We would like to receive specimens earlier in the season. When the terminal leaves begin to show injury.

THE OBLIQUE-BANDED LEAF-ROLLER.

Cacœcia rosaceana, (Harris.)

ORDER LEPIDOPTERA: FAMILY TORTRICIDÆ.

FIG. 7.
The moth of the oblique-banded, leaf-roller.

On June 11, 1894, we received specimens of the larvæ of this insect from Mr. Charles S. Pope, Manchester, Me. Accompanying the specimens were currant twigs showing the work of this insect. To make sure of the species we allowed the larvæ to transform.

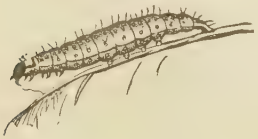


FIG. 8.
Larva and pupa of the oblique-banded leaf-roller.

This insect is a general feeder having been found upon many species of the ROSE and SAXIFRAGE families and probably feeds upon the leaves of the plants of other families. The name leaf-roller applied to this insect is derived from the habit the larvæ have of rolling the leaves of the food plant into hollow cylinders in which they live.

DESCRIPTION.

This insect may be known in the *larval* form by the pale green, yellowish green or reddish brown color with the head and top of first segment brown. There is a dark green stripe along the back and a few smooth dots from each segment bearing a short fine hair. The cut, Fig. 8 shows the larvæ somewhat enlarged. When full fed the larvæ changes to a chrysalis within the tube in which it lived.

The chrysalis is shown, Fig. 8. From the chrysalis the bell shaped moth shown in Fig. 7 comes forth.

REMEDIES.

The clusters of rolled leaves should be pinched and the larvæ killed if within reach. Spraying with pyrethnum or Paris green would kill them.

c.

b.

a.

CECROPIA EMPEROR MOTH.

Platysamia Cecropia (Linn).

FIG. 9. (a) Larvæ. (b) Cocoon. (c) Moth.

THE CECROPIA EMPEROR MOTH.

Platysamia Cecropia, (Linn.)

ORD. LEPIDOPTERA: Fam. BOMBYCIDÆ.

Every season for the last eight we have received either larvæ cocoons or moths of the above species accompanied by letters of inquiry. We have concluded to publish cuts of all the stages of this conspicuous insect. Those who wish a description will find it in Expt. Station Rept., 1890, p 121. The insect is distributed throughout the State as specimens have been received from every section.

Fig. 9 a, represents the larvæ full size; Fig. b, the cocoon full size; Fig. 9 c, the full sized moth.

THE CHINCH BUG.

Blissus leucopterus, Say.

ORDER HEMIPTERA: FAMILY LYGÆIDÆ.

In company with Hon. B. Walker McKeen we spent two days last September in the vicinity of Fryeburg examining the area infected by chinch bugs.

HISTORY.

FIG. 13. CHINCH BUG. The short line below shows natural length.

By interrogating some of the oldest inhabitants we learned that this pest has done more or less damage in the intervale lands about Fryeburg for at least twenty-five years. It does not affect the area infested uniformly, but occurs in patches, often skipping entire farms. Nor is the infested area the same from year to year. Farms infested one season may become exempt the next and those not infested one season infested the next. Then there are seasons favorable for the bugs when the damage done is greater over the entire area and then seasons of minimum damage. The insects do

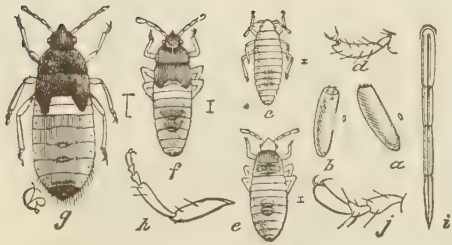


FIG. 14. CHINCH BUG, LARVA, PUPA AND EGG.

a and *b*, eggs; *c*, young larva; *d*, tarsus of same; *e*, larva after first molt; *f*, larva after second molt; *g*, pupa; *h*, leg; *i*, beak or tubular mouth; *j*, tarsus of mature bug.

not occur in such hordes as they do in the West even in the worst infested farms. In small fields there were many isolated patches of a few feet or rods in extent. Only in one or two places did we find large continuous areas infested. They were the worst in the low, sandy lands, but were found in some places on the uplands, notably on the farm of Charles Chandler, Fryeburg Center.

RECORD OF OBSERVATIONS.

We began our observations at the farm of Mr. B. B. Woodward, N. H., where we found the bugs in abundance, in small patches in grass lands. This farm is the *southern limit* of the infested area so far as we know, though they may be found farther south. Proceeding north we visited the farms of E. W. Burbank and Henry Andrews, where the insects were working in patches. The grass was dead and dry in one of these fields and the bugs were abundant on the edges of the dead patches extending their depredations. We burned over one of these patches to see what would be the effect on the bugs, and found that only a few of them were killed. They work so deep about the roots of the grass that the heat does not reach them.

At the farm of Charles Chandler, Fryeburg Centre, they were working upon the uplands and at George A. Charles' farm they had destroyed the whole field. At the farm of Wilson Webb they had been working in a field of corn. They had destroyed the adjoining grass land and injured a few rows of corn at the edge of the field. We found a large number of dead bugs covered with mold in the sheaths of the leaves but was not able to decide that the fungus was the cause of their death.

The fungus proved to be a common mold and originated, probably, in the juices exuded where the leaves were eaten and finally extended to the dead insects. So far as we could learn but little damage is ever done to corn by this pest. They were doing much damage on

John Hastings' land near the above corn field. At Dexter Walker's there was a fine field of corn adjoining grassl and badly infested. It would seem that they do not leave the grass for corn as long as the food supply holds out. Mr. A. K. Price had already plowed his grass land to destroy the insect. If the bugs are bad the land would have to be reseeded and by plowing early and deep, the bugs would be buried and destroyed. We called on Mr. Simeon Charles from whom we originally received specimens and found his fields infested. The most northern place of their occurrence known to us positively is the farm of Albion Wyman, North Fryeburg, but we have good reasons for believing they occur about Bethel, twenty-five miles further north. They occur throughout East Fryeburg and also in Bridgton, the township on the east. We stopped at several other places than those mentioned and noticed the work of the bugs in several fields as we drove by. The above places mentioned will outline the infested area, which would appear to be about seven miles long by about two wide. Those who wish a description of this insect will find an account of it in Experiment Station Report, 1892, page 124, besides other information historical and remedial.

REMEDIES.

In Illinois and other western states where the chinch bug occurs in great numbers, over large areas, attempts have been made to destroy them by infecting with fungi, the principal one being (White Muscardine, *Sporotrichum globuliferum*, Speg.)

The results of these experiments have been so uncertain that we regard any attempt to control or destroy the pest by this method in Maine as time wasted. The fact that the insect works in isolated patches makes the problem in Maine a different and difficult one. In the West the bugs affect the wheat and small grain early in the season and as soon as this is harvested they migrate in hordes to the corn fields. In Maine small grain is not grown to any extent. Before haying the bugs live on the grass leaves and after haying do not migrate but transfer their depredations to the roots of the grass, killing everything as they go, remaining in the grass land as long as food supplies hold out They are particularly destructive to timothy grass lands. Chinch bugs are very sensitive to wet weather and are never so bad in damp, rainy seasons.

The following suggestions may prove helpful in checking the pest:

1. Watch the fields after haying and if the bugs begin to work in patches as shown by dead places in the grass then *at once* spray the living grass for a distance of ten feet where the bugs are feeding along the edges of the patches with kerosene emulsion.

2. Should the bugs appear over the whole or the greater part of a field there is no hope of saving it but in order to destroy the bugs the land should be plowed deep and rolled as soon as possible after haying.

3. So far as possible it would be well to burn grass lands. The burning destroys some and the remainder are more exposed during the winter to injury. After haying or early in the fall all rubbish about the fences and border of the fields should be raked in heaps. The bugs will seek the rubbish for winter quarters. The rubbish should be burned late in the fall or very early in the spring.

4. The chinch bug feeds only on plants of the grass family. Fields badly infested could be planted to clover, buckwheat, beans, potatoes, turnips, etc., and the bugs starved. Frequent rotation of grass with the above crops would tend to keep them in check. If by concerted action all of the infested field in the area could be turned after haying the same season, it would go far toward destroying the pest. Whatever method is adopted there should be concerted action. The chinch bug does not travel very much and the application of remedial measures and its suppression becomes largely an individual matter. No farmer can lay the blame for its presence and depredations upon the inactivity of a shiftless neighbor.

THE BUFFALO CARPET BEETLE.

Anthrenus Scrophulariæ, L.

ORDER COLEOPTERA: FAMILY DERMESTIDÆ.

During the last few years we have received letters from the western and southwestern part of Maine regarding an insect doing much damage to carpets and woolen clothing. Several times these letters have been accompanied by specimens, leaving no doubt that the pest is the insect whose name appears at the head of this article. This insect is called the buffalo bug in Maine, but in other localities is variously known as the carpet beetle, buffalo carpet beetle and buffalo moth.

Perhaps the many common names given to an insect is of little importance, but they are confusing and are apt to annoy the systematist who insists upon exact use of terms. To the practical man the important points are identification; a knowledge of how to cope with it, if injurious, and how to utilize its good qualities if beneficial.

This insect belongs to the order Coleoptera, which embraces the hard-winged insects called beetles. To call it a "bug," which is the name belonging to insects like the squash bug (*Hemiptera*), or to call it a "moth," which is a term restricted to a portion of the scaled winged insects (*Lepidoptera*) would be entomologically incorrect. This insect is properly called a beetle, and in allusion to the shaggy appearance of the larvæ, and the fact that it injures carpets the name Buffalo Carpet Beetle would be appropriate.

HISTORY AND DISTRIBUTION.

The insect was first described by Linnæus in 1758. On account of its feeding upon plants of the genus *Scrophularia* he named it *Anthrenus Scrophulariæ*. It is now known, however, to feed upon a wide range of plants including fruit trees, tulips and roses. Though a vegetable feeder by nature it readily changed its dietary and in Europe as early as 1779 was known to frequent houses and to destroy collections of insects and plants, clothes, furs, leather and victuals. It was known in Europe in 1855 as The Common Flower Beetle. It is an interesting example of the power

some insects have of adapting themselves to new surroundings and new food.

Though known in Europe for over a hundred years, it was not detected in America until 1850, when Dr. Le Conte found a variety of it on flowers in California. It was, according to Le Conte, probably imported during the Spanish occupancy of that country. It was on the Pacific coast that it was rechristened "the buffalo bug."

In the Eastern states they were first discovered near Buffalo, New York, in 1872, and a little later in Massachusetts. Dr. Hagen investigated the matter in Boston, and found that the infested carpets came largely from a single large carpet house, and he inferred that the pest was introduced in imported carpets

Since its introduction it has spread more or less, and is now known in all of the New England states, as far west as Illinois and as far south as Washington. In Europe it has not figured as a carpet beetle, as carpets are little used, and rugs more common. The insect is retiring in his habits and does not thrive in rugs, which are frequently taken up and shaken. Perhaps in the growing custom in this country of using rugs, housekeepers will find a means of controlling this insect, which is now in many localities the greatest household pest.

We have but little data regarding their introduction or even distribution or prevalence in Maine. Nearly eight years ago we received a single complaint, and presume they have been in the State for years. They probably came in from the way of Massachusetts through carpets purchased in Boston. We have had complaints from Bangor and Belfast, the eastern part of the State. This article, we hope, will call attention to the pest and bring it to light and help determine its distribution. We will be pleased to examine any carpet insects sent us, *but be very careful if specimens are sent to put them in a tight tin or metal box, which should be enclosed in an outer wooden or pasteboard box.* We would also like to have those who know positively that the buffalo carpet beetle is in their neighborhood send a postal card to that effect. There are several other small beetles that destroy carpets, also carpet moths, and besides other harmless small beetles are often found in houses, and are liable to be mistaken for this pest. The only safe way is to have the insect identified by an entomologist. Prof. Lintner gives a case where a

beneficial beetle (a lady bug) was mistaken for the buffalo carpet beetle.

DESCRIPTION.

Eggs—We find no description of the eggs in any work at hand and have no specimens to examine. They must be very small, and the belief is that they are laid by the female on the carpet or clothing attacked and not in the cracks of the floor, as some suppose.

Larva—The full grown larva is about a quarter of an inch long, dark brown and clothed with stiff brown hairs which are longer on

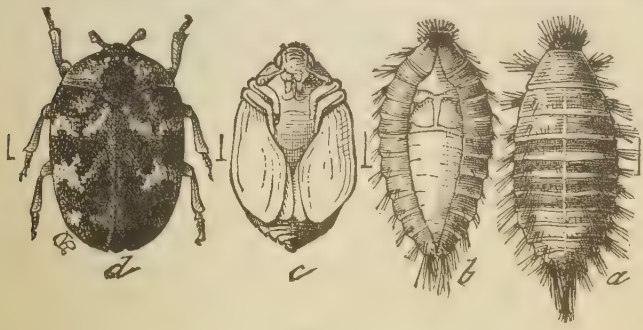


FIG. 10.

the sides than on the back and still longer on the extremities. These hairs form tufts at the sides and extremeties. The posterior end bears three tufts of long hairs and the head a bunch of shorter ones. Fig. A shows the back view of the larva much enlarged, the real size being shown by the hair line at the right. Fig. B shows the under side enlarged.

Pupa.—It is shown in Fig. c, enlarged. The real size being shown by the hair line at the left. It is brown in color and is the quiescent stage in the life history of the insect between the larva and the perfect beetle. The larva moults six times at least in coming to maturity, and finally the pupa is formed in the last larval skin, and after a time this larval skin splits open along the back, revealing the pupa from which later the full grown beetle emerges. The cast-off larval skins are usually found in abundance, giving the impression of a greater number of the pest than really exists. The larva are very tenacious of life and will go a long time without food We kept some one time in a tin box for nearly a month without food, and they were still alive. When deprived of food the growth is slow and the moults more numerous. It is the larva that does the mischief.

Perfect Insect.—A beetle three-sixteenths of an inch long and nearly as broad. The broadly elipical outline is shown in Fig. a, which is enlarged, the real size of the beetle being shown by the hair line on the left. The beetle is black and white and scarlet. The ground color is black with three irregular white bands across the wing covers [elytra] and a scarlet stripe down the middle of the back widening at three points to meet the three irregular white bands. The antennæ are black, eleven jointed and bearing a three jointed club at the end. The head is black marked about the eyes and mouth by a few orange red scales. Under side of the body black with red and white scales. The color is variable. Sometimes the red band down the middle of the back is white and sometimes the two anterior white bands are confluent, forming a broad band of white.

LIFE HISTORY.

The beetles begin to emerge in the fall and continue to appear during the winter and spring. There is believed to be but one brood in a year, though the time of emergence of the beetles would depend upon the conditions of heat and cold and food supply in the houses and rooms frequented. In heated houses and rooms they would transform more rapidly, while scarcity of food has been shown to prolong the life of the larva and increase the number of moults. When on the wing they may be found often on window panes and in the fall out of doors upon plants of the sunflower and figwort families. Though Professor Riley thinks they lay their eggs in the house before they leave it we see no good reason why they may not, as they do in Europe, lay their eggs and maintain themselves out of doors. The beetles soon pair after they merge and the eggs are supposed to be laid upon the clothing and carpets effected. The eggs soon hatch, if the temperature is favorable, and the young larvæ attack the exposed edges of the carpet, clothing, etc , often following a single thread or stripe in a carpet for a long distance. When mature, in the fall, having moulted at least six times, they seek cracks in the floor or other places of concealment and transform to the pupa state within the last larval skin. The pupæ finally ruptures along the back and the beetles emerge, completing the round of life.

REMEDIES.

Difficulties.—This is a very difficult insect to exterminate, the despair of the shiftless housekeeper and nearly a match for the fastidious, uncomfortable ones who are ever upon the alert for the last speck of dirt and first indications of insect pests.

It does not readily yield to the ordinary insecticides like camphor, cedar oil, pepper, tobacco, turpentine, carbolic acid and pyrethrum, etc. Benzine when properly applied has been found to be the most convenient and best remedy. Even with this the most energetic and persistent measures are necessary. The aim should be extermination of the pest in the house, as a few overlooked would multiply rapidly and increase the difficulty.

Precautions.—[*a*] There are quite a number of carpet insects, beetles and moths. The first step should be the positive determination of the pest doing damage Learn to recognize the larvæ, pupæ and beetles and then wage a ceaseless war against them in every stage of their life history. If you do not know the insect, or can not decide from the description given above that it is the buffalo carpet beetle, then put some specimens in a tight metal box and send them to the entomologist of the experiment station at Orono, Me., and he will cheerfully name them.

[*b*] Remember that benzine is an inflamable liquid. Do not bring a light near it. Do not apply benzine to a room in the evening when lights are burning or enter a room with a light when it is filled with the vapor. It is well enough to keep a room closed while the benzine is being applied so it will not evaporate too rapidly. The strength of the vapor favors the destruction of the larvæ and beetles.

Having decided that you have the buffalo carpet beetle to grapple with, then apply the following remedies.

PREPARATION OF ROOM.

As the larvæ crawl into cracks in the floor and under the baseboards to transform, precautions should be taken to fill, so far as possible, these hiding places.

a. Fill the cracks in the floor and the crevices at the bottom of the baseboards carefully with a moderately thick mixture of plaster of paris and water. This will set hard and prevent their entrance.

b. Should the use of plaster of paris be inconvenient or undesirable, then, by means of a hand-atomizer charged with benzine, puff the liquid thoroughly into all the floor cracks and crevices about the baseboards. It would be well to leave the carpets off a few days and make the second application of benzine before putting them down.

c. When cleaning house it is best to take up all the carpets at once, and thoroughly clean all the rooms before putting any of the carpets back. The common way of cleaning one room at a time and returning the carpet at once would give the pest a chance to fly or crawl from one room to another while the work is going on.

d. It has been recommended to put a strip of tarred roofing paper around the border of the room before the carpet is laid. This would no doubt help to repel the attacks of the beetles and would be desirable if the odor was not objectionable. The odor of napthaline, gasoline and bisulphide of carbon and kerosene make the use of these efficient remedies undesirable in the house. A tight box filled with the vapor of bi-sulphide of carbon from above is used by naturalists to disinfect museum specimens and it could be used to disinfect carpets out of doors. It is very volatile and highly inflammable. The vapor is very heavy, being two and a half times as heavy as air and settles rapidly.

PREPARATION AND CARE OF CARPETS.

a. In Europe this beetle is not known as a carpet pest because the use of carpets is not common. Rugs which can be taken up and frequently shaken are more in use than in this country. In a badly infected house it would be well, if possible, to discard the use of carpets for a time and use rugs, taking them up frequently and shaking them. A more extreme measure would be to discard carpets and rugs for the summer season. If carpets are used they should be taken up at least twice a year, thoroughly beaten and lightly sprayed with benzine and left out of doors until the benzine evaporates. Leaving carpets down the whole season and then cleaning them carelessly gives the pest fine chances to increase unmolested.

b. As the larvæ attack the exposed edges of carpets, they are usually found around the border of the room.

If the depredations of the insect are noticed between the times of house cleaning and it is not convenient to take up the carpet

then take a damp, folded sheet or cloth and spread it smoothly over the infested spot and iron it thoroughly with a hot iron. Allow the iron to remain long enough to generate steam sufficient to penetrate the carpet and destroy the insects. If thought desirable the whole room could be so treated but the benzine method would prove less laborious. Some leave the carpet untacked and turn the edges back occasionally and examine them carefully.

c. When you buy a new carpet from a local dealer in the infested district, or import one from the larger cities, it would be well to examine it carefully and spray it with benzine before putting down. There is no doubt that the pest was introduced in carpets purchased in the city or cities where the pest has been found in the large carpet houses.

d. The custom of sending carpets to the cleaner has its danger as a cleaning house would be very apt to harbor the pest. When returned, carpets should be sprayed with benzine before putting them down.

e. Carpet cleaners in the infested district could easily arrange to give all carpets a dry hot air or steam bath of from 160° to 200° and thus thoroughly disinfect them after they are cleaned.

f. Carpets to be stored for the summer should be thoroughly beaten, disinfected by spraying with benzine and put into a tight box, the cracks of which have been previously sprayed with benzine. A box can be made tight by pasting paper over the cracks. Some line boxes with tarred paper and sprinkle napthaline crystals (*crysta alba*) in the fabric. This is better than camphor gum and is a good expellant, is cheap, and leaves no stains or offensive odors behind.

Care of Clothing.—Clothing to be stored should be treated as recommended for carpets. Drawers or boxes in which infested clothing has been stored should be thoroughly sprayed with benzine.

Furniture.—Cloth covered furniture should be thoroughly steamed or sprayed with benzine.

If the methods advocated above are carefully applied for two or three seasons, even so difficult a pest to exterminate as *Anthrenus Scrophulariæ* will be compelled to yield.

THE OAK-BARK WEEVIL.

Magdalis olyra (Herbst).

ORDER COLEOPTERA: FAMILY CURCULIONIDÆ.

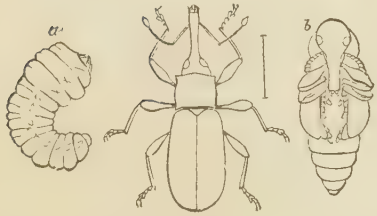


FIG. 11. Larva, pupa and beetle of Magdalis olyra.

Specimens of the above insect were received from Mr. B. Walker McKeen and sent him by Mr. Delano Moore of Presque Isle. They were said to be feeding on the leaves of elm trees in that region. This being a new habit for this species we wrote Mr. Moore asking him to send more of the insect and some of the leaves upon which it was feeding. Here we give a cut of one of the leaves showing the nature of the work. Mr. Moore writes that this species was also very abundant upon hazel bushes in June, destroying the leaves. We sent some of the beetles to Dr. Horn, who pronounced them the above species.

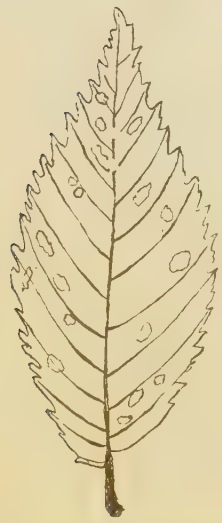


FIG. 12. Elm leaf eaten by Magdalis olyra (original).

Dr. Packard says [in Forest Insects, p. 80] that this species infests *oak trees*, the larvæ living under the bark. We do not know whether the larvæ attack elm trees or not, but possibly this is so, as the perfect beetle feeds on the leaves. This species can be recognized by the cut and following description: Color dark reddish brown to nearly black, clothed with short lighter colored hairs. The base and tips of femora and rest of the legs including the antennæ pitchy reddish. Length one-fourth to one-third of an inch.

We know no remedy. Should it confine its attacks largely to hazel bushes it would be more beneficial than otherwise.

THE FALL CANKER WORM.

Anisopteryx pometaria, Harris.

When we first began to observe this insect in 1887 it was not very abundant about Orono and did no material injury. It gradually increased from year to year and in 1893 had become so abundant as to do much damage to orchards and shade trees. The foliage of trees on the college campus and in Orono were so badly eaten that it was feared they would die. For some unknown reason, probably from the increase of parasites that prey upon this species, it almost entirely disappeared during 1894 and has given no trouble whatever about Orono in the summer of 1895. The insects seem to be migrating or passing over the State like a slowly moving wave from the north toward the south. Its depredations have gradually spread down the Penobscot valley. In 1893 they were very abundant in Arnold and Prospect and this season (1895) they are doing so much damage to the shade trees in Thomaston that a town meeting will be called to consider the means necessary to check them. Mr. E. P. George, President Thomaston Improvement Company, writes that "canker worms appeared upon a few of our fruit trees about four years ago. They have increased in numbers each year and gradually spread to the elms until this year fully three-fourths of the eight or nine hundred elms and fruit trees in the village were completely infested and deprived of their foliage by the end of June." The trees about Orono were not killed. They no doubt suffered a severe shock and the growth for a season or two was greatly checked but they seem to have regained their usual vigor. It took the worms about five years to reach the period of greatest numbers at Orono and if they have the same experience at Thomaston with them they will not be so abundant next season. It is well known to entomologists that insects have gradual periods of increase and then suddenly decline. We had a very good example of this in Maine in the case of the Forest Tent Caterpillar, which is fully explained by rapid increase of parasites, (see Station Report 1890, page 138)

Report of Veterinarian.

F. L. RUSSELL.

TUBERCULIN AS A DIAGNOSTIC AGENT.

No apology need be offered for a report relating to bovine tuberculosis. The importance of the subject is excuse enough. Those who are impatient at the amount of attention the subject is receiving from all quarters need to realize its importance more fully than they do. It is doubtless possible to take extreme ground in advocating the importance of tuberculosis from a sanitary and economic standpoint, but the general public is so far from realizing the true importance of the matter that there is need of even these extremists. There is no safety in ignorance or indifference. Safety consists in recognizing existing dangers, and adopting the most efficient means of combating them. The world moves; and this is true even in relation to medical science and it has been especially true during the last ten years. Greater advance has been made in our knowledge of the causes of disease during the past ten years than in the fifty years preceding. And with the increased knowledge of the causes has naturally come a corresponding knowledge of the means of preventing and of curing disease. The magnitude of this progress, and its far reaching results in prolonging life and preserving health it is yet difficult to realize.

The most progressive and enlightened can hardly comprehend it, and it is in no way strange that the public that is to be directly benefited is somewhat slow to accept facts that are new and not well understood. Knowledge must always be in advance of practice, and there are never lacking those extremely conservative individuals who cling to the old until nearly everybody else has acknowledged the value of the new. These individuals have their place, no doubt, and act in some measure as a balance wheel, but progress is made in spite of them and not with their help. There are those even at the present time, who are decrying vaccination against small pox and insisting that it does more harm than good

REPORT OF BOTANIST AND ENTOMOLOGIST.*

Prof. F. L. Harvey.

Professor W. H. Jordan:

Dear Sir:—I have the honor to submit herewith my eighth annual report as botanist and entomologist for the experiment station.

The work of the season has been along the usual lines, embracing field work upon injurious plants and insects, laboratory investigations upon the life histories of insects and plants, preparation of material to illustrate lectures upon insects and weeds, lectures, preparation of articles for the press, correspondence and preparation of this annual report.

The most important field and laboratory work was upon the life history of *Trypeta* (*Epochra*) *Canadensis* (*Loew*) a fly doing much damage by stinging currants. This consumed considerable time during the summer months and the results of the study are given in the body of the report.

Boxes for storing specimens showing stages in the life history of a single insect, or small group of insects, have been made and the work of collecting and preparing specimens is in progress. These will be useful for comparison in study and determination of species and to illustrate talks upon insects before winter course students and farmers meetings.

A complete collection of weeds and forage plants is in process of preparation and will be useful for naming specimens sent for determination and to illustrate lectures.

Besides the local lectures to winter students in agriculture upon injurious insects and fungi, several appointments to lecture have been filled in various parts of the State; two for the Pomological Society at Presque Isle, two for the Board of Agriculture at West Rockport and Washington in Knox county, three at North Berwick, Saco and Cornish in York county; one at Turner Centre in Androscoggin county and one at North Jay, Franklin county, and two for granges at Fryeburg Centre and Monmouth. The subjects treated were Native Cranberries, Orchard and Farm Insects, Fungi and Weeds. At most points two subjects were considered.

An article upon Cattle Lice was written for the Lewiston Journal besides articles for other State papers, and also several papers of a technical nature upon the plants and animals of Maine were contributed to natural history journals.

*Report from the Maine Agricultural Experiment Station: Entomology, No. 10.

As you are to sever your connection with the Maine Experiment Station at the close of the year I wish to thank you for the interest you have always taken in my work and for the liberal provision which has always been made to aid me in my investigatons and to express my regret thet such pleasant personal relations cannot continue.

Directions for Sending Specimens

will be found in the annual report of the Experiment Station, 1888, page 194 or in the Maine Agricultural Report 1888, page 158.

Correspondence.

It is the duty of the Station Botanist and Entomologist to answer questions regarding plants and insects that are of economic importance. Any citizen of Maine may avail himself of this privilege. Correspondence is therefore invited. We would particularly like to have farmers send us specimens of weeds they find in their fields as we wish to study the distribution of weeds in the State.

Below will be found notes upon the plants, and insects of importance that have claimed attention during the year. Those requiring detailed consideration are treated in the body of the Report. The usual tables of record of plants and insects are given below.

NOTES ON PLANTS.

Berteroa Incana, a cruciferous weed mentioned in our last report seems to have established itself, as specimens were received again this season. The various species of the mustard family are abundant in Maine.

The Dichotomous Catchfly, which was received from so many sources last year was not reported this season. Being an annual and such a coarse conspicuous plant the farmers probably cut it before seeding, and will have no further trouble with it.

The Common St. John's Wort, was received from South Rumford. This species is common in Maine, and is a pernicious weed. A perennial with a tough root. It is common in pastures, roadsides and thickets.

The Wild Carrot was found to be quite abundant in Knox county where it has become well established along neglected roadsides.

The Common Evening Primrose is quite abundant in various parts of Maine. It was considered in Board of Agricultural Crop Bulletin for August, 1895. Its large yellow flowers built on the plan of four and its size make it a conspicuous weed. It is not so common as the sundrops mentioned in our last report.

The Yellow Bed Straw was received for the first time the past season. It occurs as a weed in fields in Carroll.

The Canadian Golden-rod is a common coarse species very abundant in fence corners and about pastures and thickets. It is usually associated with two or three golden-rods, asters and compositae.

The Cone Flower or Yellow Daisy as it is called in Maine is distributed throughout the State. It was introduced with grass and clover seed from the West.

The Scabrous Hawkweed a native species was received from several parties. It is related to the Orange Hawkweed, but is not nearly so bad a weed. The native species is found in open woods, thickets and grass lands. It has yellow blossoms and a leafy stem. The Orange Hawkweed has dark orange flowers.

The Giant Laural (*Rhododendron Maximum, L.,*) was received from Mr. C. S. Phinney of Standish. This is a rare species and the letter regarding it printed in the body of the report will be interesting.

The Clover Dodder reported last season, seems to be abundant having been received this season from Kennebec, Penobscot and Piscataquis counties.

The Creeping Thyme was reported for the first time. It is a weed belonging to the mint family.

The English Plantain is still being shipped into the State in clover seed. It was found in two samples of seed examined the past season.

The Black Bindweed, a common twining plant belonging to the same family as the smartweeds, docks, sorrels and buckwheat, was received from Piscataquis county. It is a plant introduced from Europe, and the seed abundant in western oats.

Bastard Toad Flax was reported from Sanford. It is not common in Maine. We have not seen it in Eastern Maine.

There has been no great damage done by fungi in the State the past season. The Apple Scab was more or less prevalent as usual. Not a single letter was received about other fungi. The dryness of the season would no doubt account for it.

NOTES ON INSECTS.

The Long-nosed Ox Louse was reported as very abundant on cattle in the vicinity of Thomaston, and from specimens sent by Mr. A. W. Batchelder, we were able to describe and figure the egg of this species which was not known before. This species is rare, the species found on cattle being more commonly the short-nosed louse, or sometimes the biting louse of cattle. An article upon cattle lice written for the *Lewiston Journal* is found in the body of the report.

The Woolly-Louse of the Apple was reported as feeding upon raspberries.

The Chinch Bug was found last August in a pasture in Moose River township about a mile from Jackman. The location was a sandy hillside. Quite large sports were infested. This species has been reported from Bethel about twenty-five miles north of Fryeburg. The new locality is fully 100 miles to the northeast.

The Yellow Woolly Bear was reported as feeding upon raspberries. It has not been reported to the station before and therefore will be considered in this report.

The Apple-tree Tent Caterpillar was received. This common insect should give no trouble as it is so easy to remove the egg clusters from the branches during the winter when the trees are leafless.

The Clothes Moth, (*Tinea Pelionella, L.,*) was found eating holes in carpets and shawls at Augusta.

The Mourning Cloak Butterfly did considerable damage to the foliage of elm trees about Waterville the past season.

The Currant Fly, (*Trypeta (Epochra) Canadensis*) is doing considerable damage to currants in Maine. The fly stings the fruit and deposits an egg. The habits are much like those of the apple trypeta. This speces is considered, and illustrated in the body of the report.

Paoria Gilvipes, a small black beetle appearing the last of April or early in May, was reported as doing great damage by eating the buds on raspberry canes. Attention was called to this fact through the public print. In the body of the report the life history is given. This beetle is capable of doing much damage and has been a great nuisance to strawberry growers.

The Cucumber Flea Beetle was reported as eating holes in petunia leaves. This is a common insect in early gardens feeding upon the leaves of radishes, cucumbers, squashes and potatoes. It is a small black beetle that has the power of jumping. There is a species of spring tail (*Smynthurus*) very common in Maine that has about the same habits as this beetle, and is liable to be mistaken for it. It is about the same size, jumps and eats small holes in the leaves. It should be called a garden flea, and may be distinguished by having long antennae and a forked jumping organ. It has never been described in the books.

The Larder or Bacon Beetle is very abundant in Maine. The disgusting hairy larvæ are well known to most house keepers. The insect is considered in the body of the report.

The Pear Tree Slug continues to do some damage to the foliage of plum, pear and cherry trees. This insect was considered and figured in Station Report 1888, page 176.

The Gall Fly (*Rhodites sp.*) In 1891 we found quite a number of moss like galls upon roses in the garden of Eben Webster, Orono, and reared from them the flies. Some of these were sent to Prof. Riley, who made the following reply:

"Your No. 3, is something of a puzzle. The gall is like that of the ordinary *Rhodites rosae*, but insect differs in the very important respect of totally lacking the parasidal sutures, a character which is at least of specific importance." We do not know whether the species was afterwards considered by Prof. Riley, nor what was done with the specimens. We did not study the insect further, and have not noticed the galls so abundant since. It is interesting to have the same galls reported from another locality, Mattawamkeag, Maine.

The black oak trees in Maine are often infested by a gall fly which produces large knotty excrescences on the branches, which are full of small holes after the insects have emerged. We have examined galls sent by Mr. Stover of Blue Hill, and find the species producing them is called by entomologists, *Callirhytis punctatus*, Bass.

The Horn-tailed Borer, a large species of saw fly that makes round holes about the size of a lead pencil in various trees was reported as laying its eggs in a maple tree.

The Apple Maggot, (*Trypeta Pomonella*) continues to be a great pest. It is spreading. Several parties have reported that by keeping the windfalls picked up or by keeping sheep in the orchard they have held it in check. As long as early apples are imported from Massachusetts, more or less infested with the larvae of this pest, our Maine towns will continue to be centres for the distribution of Trypeta.

The Buffalo Carpet Beetle seems to be spreading, having been reported as very abundant in Saco, South Litchfield and Bangor.

PLANTS EXAMINED IN 1895.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	.....	*Berteroa incana*, D. C	.....	Growing in grass lands. Introduced in 1893. Bad cruciferous weed.
2	Dichotomous Catchfly	*Silene dichotoma*, Ehrb.		
3	Long leaved Chickweed	*Stellaria longifolia, Muhl.*	D. W. Lundray, Carroll	Growing in low grassy places.
4	Common St. John's-wort	*Hypericum perforatum*, L	T. H. Thornton, South Rumford...	"A pernicious weed difficult to extirpate."
5	Lucerne. Alfalfa.....	*Medicago sativa*, L	E. P. Mayo, Waterville	Cultivated for fodder but spontaneous in fields. The specimens from Vassalboro.
6	Vetch	*Vicia Cracca*, L.....	G. G. Glover, Naples	Weed in mowing fields Bridgton. Native species but also found in Europe.
7	Cinquefoil	*Potentilla Norvegica*, L	... .	Considered in August Crop Bulletin.
8	Common Evening Primrose....	*Œnothera biennis*, L	T. H. Thornton, South Rumford....	The plants sent by Mr. Thornton were considered in August Crop Bulletin. A coarse biennial weed with large yellow flowers.
9	Wild Carrot.....	*Daucus carota*, L	E. E. Light, Union.....	Very abundant in Knox county about Union and Washington.
10	Yellow Bed Straw	*Galium verum*, L	D. W. Lundray, Carroll	Weed in fields. Introduced from Europe.
11	Canadian Golden-rod.....	*Solidago Canadensis*, L.....	T. H. Thornton, South Rumford....	Weed along the border of fields and thickets. A native species.
12	Common Fleabane	*Erigeron Philadelphicus*, L.	T. H. Thornton, South Rumford....	A common native weed. Perennial. Cultivation needed to eradicate it.
13	Called Yellow Daisy in Maine } Cone Flower. Nigger-head elsewhere ..... }	*Rudbeckia hirta*, L.....	T. H. Thornton, South Rumford.. } E. B. Haynes, Monson ..... }	A western species. Introduced in grass and clover seed from the West. Not abundant nor especially dangerous.
14	Scabrous Hawkweed.....	*Hieracium scabrum*, Mx	Several parties	A native species in open woods and pastures. Has yellow flowers. Not dangerous.

15	GREAT LAUREL	*Rhododendron maximum*, L	C. S. Phinney, Standish	Sent to be named. Rare in Maine. See letter in body of Report.
16	CLOVER DODDER	*Cuscuta Epithymum*, Murr	F. H. Parlin, East Winthrop I. N. Lapham, Pittston E. G. Lovejoy, Medford Center	A parasite upon red clover known by the fine yellow threads and clustered white flowers. Introduced from Europe.
17	CREEPING THYME	*Thymus serpyllum*, L	I. T. Merrill, China	A single bunch found on the farm. Not noticed before.
18	RIBGRASS. ENGLISH PLANTAIN.	*Plantago lanceolata*, L	J. H. Barton, West Windsor H. A. Sprague, Charlotte	Plant growing in fields. In sample of clover seed inspected.
19	WATER SMARTWEED	*Polygonum amphibium*, L	Abner T. Wing, Weld	Growing in bog hole from which muck had been taken.
20	BLACK BINDWEED	*Polygonum Convolvulus*, L	E. G. Lovejoy, Medford Center	Weed in fields.
21	BASTARD TOAD-FLAX	*Comandra Umbellata*, Nutt.	O. H. Perkins, Sanford	Weed in field. Not common. Root parasitic on roots of trees.
22	REED CANARY GRASS	*Phalaris arundinacea*, L	D. W. Lundray, Carroll	Weed in fields. Native species which also grows in Europe.

INSECTS EXAMINED IN 1895.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Long-nosed Ox Louse	*Hæmatopinus vitula*, L.	A. W. Batchelder, Thomaston	Very abundant on cattle.
2	Woolly Louse of the Apple,	*Schizoneura lanigera* (Hausm.)	Dr. A. I. Harvey, Newport	Feeding on raspberry plants. (See Station Report 1890, p. 131.)
3	The Chinch Bug	*Blissus leucopterus*, Say	F. L. Harvey, Orono	Found in pastures near Jackman, Me., in August.
4	The Yellow Woolly Bear	*Spilosoma Virginica* (Fabr.)	M. B. Whiting	Feeding on raspberry leaves.
5	The Apple-tree Tent Caterpillar	*Clasiocampa Americana* (Harris)	E. G. Lovejoy, Medford Center.	Feeding on apple trees.
6	The Appleleaf Bucculatrix.	*Bucculatrix pomifoliella* (Clem.)	L. F. Abbott, Lewiston	Feeding on apple leaves in the vicinity of Wilton. (See Ex. Sta. Report 1893, p. 164.)
7	Clothes Moth	*Tinea tapetzella*, L.	Mrs. Andrews, Augusta	Found eating holes in a shawl and carpet.
8	Mourning Cloak Butterfly,	*Euvanessa antiopa*, L.	E. P. Mayo, Waterville	Feeding on elms. (See Ex. Sta. Report 1888, p. 187.)
9	The Currant Fly	*Epochra Canadensis* (Loew.)	F. L. Harvey, Orono	Doing much damage to currants in Maine by stinging the fruit.
10	The Spotted Paria	*Paria gilvipes* (Def.)=*Typophorus canellus gilvipes* (Def.)	W. C. Symonds, North Norway / C. L. Bray, Hebron	Attacking the buds on raspberry canes. Appearing the last of April or early in May.
11	The Cucumber Flea-beetle.	*Crepidodera cucumeris* (Harris)	W. L. Mower, Greene	Attacking petunia leaves. Common in spring on cucumbers, radishes, potatoes, &c.
12	Larder or Bacon Beetle.	*Dermestis lardarius*, L.	Mrs. Albert Caswell, New Sharon	Found about rennet, old cheese and in bread closet.
13	The Pear-tree Slug	*Selandria cerasi* (Peck)	C. L. Duncan, Wells / W. L. Mace, East Winthrop	Attacking leaves of plum, pear and cherry trees. (See Station Report 1888, p. 176.)
14	Rose Gall Fly	*Rhodites sp.* (probably new)	Stark Webster, Mattawamkeag,	Producing large mossy galls upon roses.
15	Oak Tree Gall.	*Callirhytis punctatus* (Bass.)	Austin Stover, Bluehill	Producing galls on oak trees.
16	The Horn-tail Borer	*Tremex columba*, L.	Geo. P. Billings, Clinton	Depositing eggs in maple trees in which the larva live.

BOTANY.

Second Blooming of Pear Trees.

I have received from Hon. Samuel Libby of Orono, specimens of pear tree twigs in full bloom, taken from a pear tree in the orchard of R. H. Libby of Newport. We have also received recently from Aroostook county specimens of cherry twigs bearing bloom. The following facts regarding unusual and second blooming may be worthy of record.

It is a principle well known to botanists that the last effort of a plant is to reproduce itself. When a tree puts forth unusual bloom, or bloom out of season, it may be reasonably inferred that something is disturbing its normal functions or sapping its vitality. There are several causes, external and internal, that may produce this result.

(a) If a tree puts forth unusual bloom beyond what is normal and the tree shows no other signs of injury, it would be well to look for borers in the trunk or insects that feed on the roots.

(b) Fungi that attack the foliage, or injurious insects that feed upon the leaves may so check the growth of the annual shoots that the effort to reproduce will show itself the same season in late blooming.

This is the case with the pear tree in Mr. Libby's orchard. The blades of the leaves upon the twigs shown us, were almost entirely eaten by some unknown insect, the petioles and midribs only being left. The new shoots and flower buds were formed before the insect began its attack. The leaves were almost entirely eaten, the vitality of the tree checked, and the effort to reproduce caused the tree to put forth full bloom. The insect had done its work and gone into the ground to transform when attention was called to the tree by the late bloom.

Of course a tree suffers from such a shock and the bloom for the following season is destroyed, and without leaves the plant cannot elaborate food for present or future use and is quite liable to die. A few twigs may be affected by insects or fungi and the general vitality not impaired.

(c) Sometimes when growth is checked early in the season by drought and followed by a wet fall, plants take on a second or fall growth. They put forth the flowers in the fall that normally would not develop until the next season. Of course the following season would be a shy bearing year. Fall and spring growth is shown in the trunks of exogenous trees by two narrow rings which together about equal those of ordinary years.

Advantage is taken of the tendency of plants to reproduce when their vitality is checked to bring trees into early blooming. By put-

ting a stone in the crotch, or binding a limb with a cord, or even girdling a twig or trunk the vitality is checked and the tree brought into early bearing.

CATTLE LICE.

During the long Maine winters when snow on the ground prevents animals from finding dry earth to paw over themselves, they are apt to become lousy. Cattle lice breed rapidly. A single infested animal, if neglected, will before spring become literally alive, and by close contact in the stable and yard is almost certain to spread the parasites to the whole herd. These parasites are therefore more apt to give trouble during the winter. We have recently received specimens for examination, accompanied by a request for information as to the nature of the parasites, and how to destroy them. As there seems to be a demand for information we can better serve the many by preparing an article on these pests. The following article is designed to give information regarding lice in general, and to consider more in detail, three species that infest domestic cattle. Those wishing information regarding lice that affect other domestic animals will do well to procure a copy of Bulletin No. 7, Division of Entomology U. S. Department of Agriculture, from which the cuts to illustrate this article were taken.

General Consideration.

The term louse is derived from the same root as loss and loose, and is used in the sence of damager or destroyer and applies to quite a variety of degraded crustacean and insect parasites that do more or less damage to their hosts.

All of the lice belong to that branch of the animal kingdom called *Arthropoda* (jointed-footed animals) which embraces the crustaceans and insects. To the crustaceans belong the wood lice or sow bugs, non-parasitic, and feeding upon decaying organic matter and found in damp places. Some of their near relatives are true fish parasites and together with a large number of other degraded crustaceans, parasitic on fish, sea mammals and other crustaceans, are called fish lice. Certain mites (degraded spiders) are often called lice. To this group belong the red lice or harvest ticks, and the well-known itch louse or itch mite and others. These have eight legs.

The remainder of the lice are true insects (*Hexapods*) having six legs and belonging to several orders. Insects themselves are infested with minute lice. Those known as bee lice are degraded flies (*Diptera.*) Bees are also infested by minute lice belonging to the order *Coleoptera* (beetles.)

The bark lice, plant lice, and jumping plant lice are bugs (*Hemiptera.*) They are provided with beaks by means of which they suck the juices of plants. The sucking lice of animals, embracing the head

louse and body louse of man and a large number of other species parasitic upon domestic and wild animals, are also bugs and belong to the order *Hemiptera* (half-winged insects.)

The bird lice or biting lice include a large number of species of wingless parasites that infest birds and animals, and belong to the order *Pseudoneuroptera* (false nerve-winged insects.)

With the above general consideration we proceed to consider the lice of domestic cattle, two species of which belong to the sucking lice and a third belonging to the bird or biting lice.

SHORT-NOSED OX-LOUSE.

(*Haematopinus Eurysternus, Nitzsch.*)

ORDER HEMIPTRA; FAMILY PEDICULIDAE.

HISTORY.

This species has been known from the earliest times as a cattle louse though often confused with the next species. It was accurately described for the first time by Nitzsch in 1818. It has always been regarding as troublesome, causing a disease called *Phthiriasis*, demanding treatment.

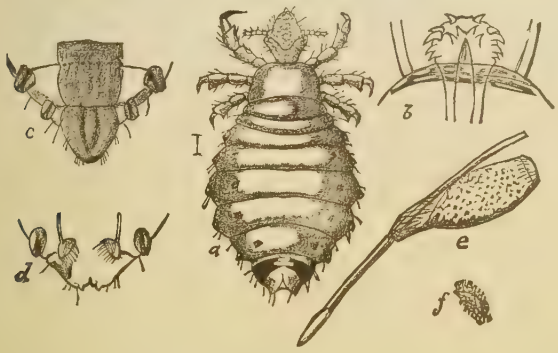


FIG. 1.

DESCRIPTION.

Females about one-eighth to one-half of an inch long and fully half as wide. Head bluntly rounded in front, nearly as broad as long. Antennae on the middle and side of the head, five jointed. Eyes very small, located upon low eminences just back of the antennae, front of the head provided with an extensible beak, which is armed

with a double row of recurved hooks (See Fig. 1 b) by means of which the parasite is attached to the host. Also provided with a slender piercing tube by which blood is drawn from the host. Thorax broader than long, widest next to the abdomen. Legs, long, adapted for clasping. Basal joint of tarsus armed with a double plate bearing fine transverse ridges. Abdomen usually flat and flask-shaped, but variable according to degree of distention. A row of tubercles along each side, in which the spiracles (breathing pores) are located. Along each side of the upper surface a row of chitinous plates. There are two brush-like organs on the under surface of the next to the last abdominal segment, (See Fig. 1 d.) The upper surface of last abdominal segment black.

Males smaller and narrower than the females. There is a broad, black stripe upon the under surface running from the posterior end of the body forward to near the middle of the abdomen. (See Fig. 1 c.) The structure of the last segments of the abdomen of the sexes is quite distinct. (See Figs. 1, c and d.) The general color of both sexes is blue slate, though somewhat variable with sex, age and condition. The head and thorax are brown or yellowish. The tubercles at the sides and the chitinous plates chestnut.

Eggs minute, elongate, oval, tapering toward the base, which is attached by adhesive material to the hairs near the roots. Surface reticulate, the crossings armed with minute points. We do not know the time required to hatch, nor the number of eggs laid. The eggs are generally called *nits*. (See Fig. 1 e.)

The young escape from the upper end of the egg, which is provided with a cap-like lid. They are like the parents only smaller, and as they mature develop the chitinous plates.

LONG-NOSED OX LOUSE.

(*Haematopinus vitula, Linn-tenuirostris*, Burm.)

Order Hemiptera: Family Pediculidae.

History.

In connection with the previous species, this louse has long been known to cattle men and entomologists, though often confused with it, as both are often found parasitic upon the same animal. The specimens we have received this winter have all been of this species.

Description.

About one-eighth of an inch long and not more than one-third as wide. (See Fig. 2.) The head oblong, nearly four times as long as wide, and widest in the middle, just behind the antennae, set well

back into a groove of the thorax and acute behind. Antennae five-jointed, located on the middle and side and usually extending forward. Thorax nearly twice as long as wide, with a breathing pore on the upper side opposite each of the second pair of legs. Abdomen oblong, wih nine segments. Devoid of chitinous plates or tubercles at the sides. Clothed, apparently, with small teeth, the outer row giving the edge of the body a finely dentate appearance. The terminal segment bilobed behind, each angle armed with about five rather long hairs. The two or three preceding segments bearing, on each side, two quite long hairs. The under side of the next to the last abdominal segment bears two brush-like organs. (See Fig. 2.) General color, bluish gray in adults. The life history of this species is much like that of the preceding species, though the details are no better known.

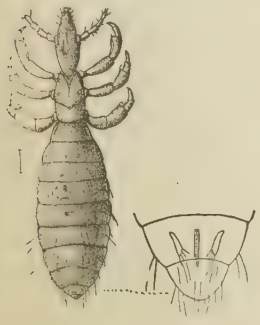


FIG. 2.

BITING LOUSE OF CATTLE.

(*Trichodectes scalaris*, Nitzsch.)

ORDER PSEUDONEUROPTERA: FAMILY PHILOPTERIDAE.

GENERAL CONSIDERATION.

This species of louse belongs to what are usually called bird lice (Mallophagans.) They are provided with mouth parts adapted for biting. They infest birds and animals, feeding upon the hairs, feathers, epidermal scales and waste products of the body of their hosts. They are said to have a suctorial organ and probably at times feed upon the blood. They are wingless, one family (Philopteridae) having the legs adapted for clasping and another family (Liotheidae) adapted for running. The bodies are usually horny and much flattened. The species are so numerous that there is scarcely a bird but what harbors one or more kinds. Some regard them as essential to the health of the host, that is, mutuals. They probably cleanse and beautify the feathers and remove wastes from the body. They injure animals less seriously than the true suctorial lice, as their principal food is wastes of the body. In great numbers, especially upon tender skinned animals, they are a source of much irritation, causing the animals to grow poor and lack vigor.

History and Distribution.

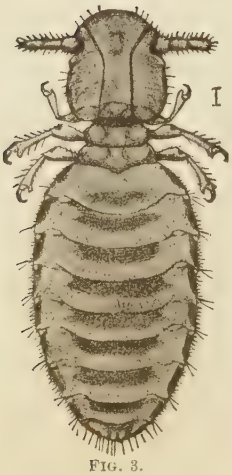


Fig. 3.

Abundant the world over upon cattle. First described by Linnaeus as *Pediculus bovis*. The present name was given it some time later and is adopted regardless of priority. The species is one of the best known animal parasites.

Description.

About one-twelfth of an inch long and of the form shown in Fig. 3. The antennae have only three joints, while the most of the bird lice have five joints to the antennae. There are dark bands across the abdomen as shown in Fig. 3. On account of the size and color they are called "little red lice" to distinguish them from the larger sucking lice that infest cattle and popularly named "blue lice." They are naturally more abundant in the spring. The eggs are attached to the hair and the young resemble in form the adults. Nothing is known regarding the number of eggs laid, the time required for them to hatch, or the time it takes them to mature, or the length of life. Here is an opportunity for some entomologist to distinguish himself, by tracing the life history of this and other species of cattle lice.

Remedies.

Lice irritate the skin. When animals are found rubbing they should be examined at once. If lice are found, separate the infested animals. Search about the neck and shoulders, at the base of the horns, around the eyes and nostrils, and along the back. Separate the hair and expose the skin. If lice are present they can generally be detected. A fine toothed comb could be used in searching. Infested animals are generally restless. When badly infested they lose flesh and the coat is staring. Bare places from rubbing appear on the neck and shoulders. It would be well to examine animals when they are put into winter quarters and not wait for pronounced cases before adopting remedial measures.

The authorized remedies for lice naturally divide themselves into four classes, viz: powders, unctions, liquids and fumes.

The powders usually employed are pyrethrum, ashes or road dust.

The unctions, mercurial ointment, and a mixture of kerosene and lard.

The liquids, decoctions of tobacco, staves acre, or the seeds of the common larkspur; solution of carbolic acid soap, or kerosene emulsion. The fumes, burning tobacco, sulphur, or phyrethum.

Pyrethrum or Persian Insect Powder should be blown into the hair by means of a small pair of hand bellows until it is well filled. Ashes could be applied in the same way or sifted over the animal and rubbed in with the hand. Dry fine road dust can be used, and like ashes probably acts by stopping the spiracles of the parasite. This last seems to be nature's remedy, as animals will throw dirt over themselves when they have access to it. The unctions should be applied about the eyes, nostrils, base of horns, upon the neck and shoulders, and along the back. The decoctions are not practical remedies during the winter, unless the animals are kept in a warm room during treatment. The liquid remedies are probably the best and should be resorted to when possible, especially in bad cases. The animals should be wet with the solution. Care should be taken that the solution is not too strong, and keep it out of the animal's eyes. The kerosene emulsion should be considerably diluted. The animals could be carded with a brush dipped in kerosene oil and the lice much reduced or destroyed.

Fumigation of the animals is sometimes resorted to, but it requires a tight box stall with a door behind and a wood stanchion in front. A canvas covering is made to fit tightly over the head of the animal, leaving only the eyes and nose exposed, while the other end of the canvas is tacked to the stall. Into this compartment through an opening, the burning tobacco, sulphur or pyrethrum is introduced. The time of exposure would vary with the strength of the fumes. Prof. Osborn found that the fumes from two ounces of tobacco and a half hour exposure was sufficient. Pyrethrum would probably do equally as well or better. The tobacco or pyrethrum could be burnt upon a piece of sheet iron heated by a small kerosene oil stove. r

EGGS OF THE LONG-NOSED OX-LOUSE.

Haematopinus Vitula, L.

After writing the article upon cattle lice we received from Mr. Batchelder specimens of hair with the eggs of the above species attached. As the egg had never been described and figured, we prepared the following account which appeared in Psyche, June 1895, but it should be put on record in the Station Report.

Professor Osborn says in his monograph "Pediculа and Mallophaga affecting Man and the Lower Animals" (Bull. 7, Div. Ent. U. S. Dept. Agric. p. 18) "that the eggs of this species have not been described, and we have not had the good fortune to discover them." Having been more fortunate we are able to submit the following account of the eggs of this species. The Long-nosed ox-louse has been quite bad this winter in herds in the vicinity of Thomaston, Maine. At our request Mr. A. W. Batchelder of Thomaston collected some hair from the infested animals, and upon this we found *three egg-shells* with the operculum off, but the form, sculpture, manner and place of attachment to the hairs seemed perfect.

DESCRIPTION.

Elongate oval, tapering toward the base. Slightly bulging on the side away from the hair in one specimen, or in the others narrower and more symmetrical. About two and a half times as long as wide. The empty shell hyaline and *beautifully sculptured with hexagonal reticulations*. The hexagons somewhat variable in size and perfectness in different parts of the shell, but average ones about one-twentieth of the width of the shell. The surface apparently smooth, the angles of the reticulations not beset with points as in the eggs of the Short-nosed ox-louse. Attached to the hair by a cement mass about one-third the length of the egg, as shown in the figure. The cement mass varies in shape, the distance it extends along the hair and the remoteness of the attachment from the root of the hair. The sloping base of the eggs is included more or less in the cement mass, and the eggs stands somewhat obliquely outward from the hair.

FIG. 4.

Below we give measurements of the three eggs observed. The figure, drawn to scale by the writer, shows the egg enlarged 40 times.

MEASUREMENTS.

Specimen (*a*,) length, .863 mm.; width, .38 mm.; width of operculum. .265mm.; from base of hair, 5 mm.; cement mass, .345 mm.; hexagonal reticulations of shell, .02 mm.

Specimen (*b*,) length, .805 mm.; width, .379.; width of operculum, .253 mm.; from base of hair, 5.75 mm.; cement mass, .288 mm.

Specimen (*c*,) length, .805 mm.; width, .379 mm.; width of operculum, .265 mm.; from base of hair, 10 mm.; cement mass, .312 mm.

THE YELLOW WOOLLY-BEAR.

Spilosoma Virginica (Fabr.)

ORDER. LEPIDOPTERA. FAMILY ARCTIDAE.

This insect was reported the past season as feeding on raspberry leaves. Though more commonly found on grapes it feeds upon various plants. The eggs are deposited in clusters on the under side of the leaves.

The young larvae feed in company for a time, but finely separate each going its way.

When full grown the larva is about two inches long and usually yellow, but sometimes straw color or brown. The segments are

armed with yellowish tubercles which bear tufts of yellowish or brownish hairs. When ready to transform the hairs are woven with silk into a cocoon. The perfect insect called "The White Miller" appears in April or May. It expands nearly two inches and is pure white with a few black spots.

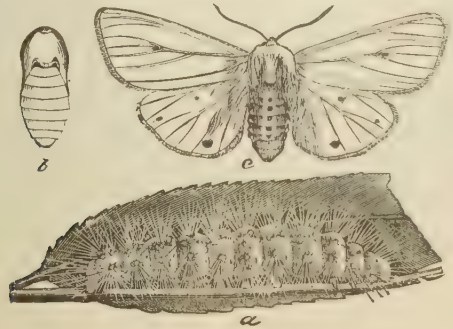


FIG. 5.

REMEDIES.

Hand-picking is the best method to keep them in check. The best time to destroy them is while the young are feeding in company and before much damage to the foliage is done.

THE TAPESTRY MOTH.

Tinea Tapetzella, L.

ORDER LEPIDOPTERA. FAMILY TINEIDAE.

A specimen of the above named cloths moth was received from Mrs. Andrews of Augusta. It was reported as eating holes in a carpet and a shawl. This is the rarest clothes moth found in Maine. Besides the above species that makes channels through cloth in which it works and does not make a case out of the fragment of the cloth, are two others which are quite common, viz: *Tinea pelionella*, L., which make little cases out of the cloth fragments in which it works, and *Tinea biselliella*, which spins a cocoon found under the infected carpet.

The above mentioned species on account of its rarety is not likely to become much of a pest.

THE SPOTTED PARIA. STRAWBERRY LEAF BEETLE.

Typophrus Canellus, Fabr. var. gilvipes, Dej.

ORDER COLEOPTERA. FAMILY CHRYSOMELIDAE.

We received the following letter, No. 1, from Mr. Bray, accompanied by specimens, which we carefully examined and named as above. We wrote him to spray with Paris green at once, and also asked a number of questions stating that this insect had been known as a great pest to strawberry growers in other states, but had not before been reported as injurous to the strawberry or raspberry in Maine. In letters No. 2 and 3 will be found the reply. After reciving Mr. Bray's second letter, to be sure that we were right, specimens were submitted to Dr. Horn and Mr. Henshaw both specialists in Coleoptera, and they confirmed the name. The fact that this insect has done no damage to strawberries in Maine, and should take to raspberries and blackberries is somewhat remarkable. It is also strange that it should appear in noticeable numbers so suddenly. Below is given an account of the insect.

HEBRON, MAINE, April 30, 1895.

Professor Jordan:

DEAR SIR—I send you some raspberry canes and a few of the insects that are eating them. I have one acre of Cuthbert raspberries and they are covered with the insect enclosed. They eat into the buds as shown on the canes sent, and I fear will ruin the crop. I had a few of the same last year. They do not seem to fly around, but crawl up the canes from the ground. I shall try spraying with "Paris green", four ounces to fifty gallons of water, but do not have much faith that it will do any good. I think there will have to be something used on the canes that they will not like the smell of to prevent their crawling up. Please tell me what they are and what remedies I had better try.

Respectfully yours,
C. L. BRAY,
Hebron, Maine.

HEBRON, MAINE, May 14, 1895.

Mr. Harvey:

DEAR SIR—Yours at hand and in reply will say that I fear you have got the wrong insect. I have raised all kinds of small fruits for the past ten years including strawberries and have never noticed the insect before last year, and then only on raspberries. I got my first raspberry plants about ten years ago from A. M. Purdy, Palmyra, N. Y., and have increased my patch to one acre from them. I have sold plants to different parties and fail to hear of any injury being done to any of them with one exception. Last year was the first time I ever saw any of the insects, and where I raised in 1893, 80 bushels of berries I got only 30 in 1894. I sold about 1300 plants last

year, but fail to find that the insect was seen on any of them after leaving me either last year or this. I have never seen any grubs in the ground except the large white grub that infests grass and strawberries. They are very numerous and I have about given up raising strawberries on account of them. There is hardly a green leaf on my whole acre, neither are there any sprouts coming up. They seem to be eaten off as soon as they break through the ground. They appeared in large numbers as early as April 15th or 20th, and damaged them so before I noticed them that I got discouraged and have not tried to do much with them. I put on about 30 bushels of wood ashes to the acre, and think that it checked them one-half or more until we had a rain when they seemed to be thicker than ever. They do not jump, but the least touch of the bushes or in walking through them talking or making much noise they will curl up and drop to the ground as though they could see or hear. I noticed they began mating about May first, but at this writing they have about all disappeared. About your questions will say:

First. They began mating about May 1st. I first noticed them about April 15th or 20th.

Second. I have never seen them jump and do not think they do.

Third. I saw them first in the spring of 1894, they were quite plentiful and did much damage.

Fourth. I have grown strawberries, but never saw them infested with this insect.

Fifth. I bought 100 plants from New York ten years ago, and and have increased my patch from them. Have sold a great many plants to different parties, but fail to hear of them being infested on any of them with one exception.

Sixth. I have never noticed any white grubs about the roots. Any further information that I can give you will be cheerfully given, as I want to be prepared to fight them next spring.

Yours truly,
C. L. BRAY,
Hebron, Maine.

Thinking it desirable to find out how widely this pest was distributed in the State, we put the following letter into the Bangor, Lewiston and Augusta papers.

ORONO, Me., May 13, 1895.

We desire to call attention through the columns of the Journal to a small black beetle about one-eighth inch long that is reported as climbing up raspberry canes and eating the opening buds. This is one of the worst pests to the strawberry grower, and should not be neglected.

These beetles hybernate and come out early in the spring doing great damage to the flower buds. They soon mate and lay eggs for a second brood. The grubs live in the roots of the plant and later appear as beetles and in the summer devour the foliage. Those killed now will prevent the increase.

The canes should be sprayed at once with Paris green, one pound to 200 gallons of water, or one pound of fresh white helebore to 50 gallons of water. To ascertain whether this beetle is common in the State and also to learn whether it has been known to feed upon raspberry plants, we would be pleased to hear from any one who has observed it; to make the matter certain, a few of the beetles and a cane with the buds injured should be sent in a wooden box, or, if working on strawberry leaves, the beetles only need be sent.

F. L. HARVEY, Entomologist,
Experiment Station.

In response to the above notice we received the following letter and a package of the above named beetle.

NORTH NORWAY, Me., May 16, 1896.

DEAR SIR—Noticing your communication to the Lewiston Journal in regard to the raspberry flea-beetle, will say, that a small brown jumping beetle, hard to catch, has done considerable damage to my half acre of Shaffer raspberries. Have not seen them on strawberries, but have seen them on blackberries, but they did but little damage. They are especially injurious to raspberries that leave out late. I have collected a few of the insects and mail them. They are not a jumping animal, but fall and play dead on being disturbed.

Yours truly,
W. C. SYMONDS.

Below we give letters received this spring just as we are completing our report and insert them as additional information upon this pest.

HEBRON, Me., May 12, 1896.

Prof. F. L. Harvey:

DEAR SIR—The bugs came on to my raspberries about April 20th, and it has been a fight between us two which would win, but it now looks, as you will see by the canes sent, as though the bugs would conquer. I have never raised but a very few strawberries and have never seen any of the bugs on them. Last year I looked the few vines I had over very carefully, but failed to find any of them. I have sprayed the most of the piece with Paris green, one to fifty gallons water, but can see no difference, and doubt very much if it will do any good as they take the bud before it begins to open and eat the inside all out, so you see it would be a difficult job to get the poison where they would get it. The only way that I can see is by hand killing. I have never seen any of the bugs jump, but they will roll off the bushes as soon as disturbed. I also send you a bug that is longer and lighter colored. (There seems to be two colors of the bug I sent you last year. One a shiny black, and the other a little reddish, perhaps male and female.) I find them quite plenty on the raspberry bushes that have got some leaves. The black bugs eat the sprouts in the ground, as you will see by the root sent.

Very truly,
C. L. BRAY.

North Norway, Me., May 5, 1896.

Mr. F. L. Harvey:

Dear Sir—The beetles referred to have appeared in large numbers. They can be seen flying on warm days near the patch. They attack everything in the shape of raspberries and blackberries, wild or cultivated. They have never yet done the blackberries much harm, seeming to prefer the blackcaps. They do not molest the strawberries close by. I did not spray last season. I have not noticed a second brood.

Yours truly,
W. C. SYMONDS.

History.

This insect was first reported injurious to strawberries in Canada, as early as 1873. Since then it has done considerable damage to strawberries. The larvae working in the roots and crown of the plant and the beetles eating the foliage. It is a general feeder (polyphagous) being known to feed upon juniper, walnut, hickory, black locust, hypericum, solidago, etc. Prof. Forbes reports it feeding upon raspberry leaves in 1884, but does not say it did serious damage. The cases referred to above would seem to be the first instances of great damage being done to raspberries and so far as we know, injury to the buds early in the season has not been reported. So far as we know it has never before been found feeding on blackberries. It has never been reported to the Station as doing injury to strawberries in Maine. That it should first appear in injurious numbers upon an unusual food plant is strange. The larvae have hitherto only been found in strawberry roots. It will be interesting to learn whether the raspberries were near strawberry patches, and whether the larvae attack the roots of raspberries and blackberries. The following description of the larva and pupa we take from Prof. Forbes' account, as we have not had them for study.

Description.

Larva—"White, 3 to 4 mm.; (.12 to .16 in.) long, and half as wide. The head and first segment pale yellowish brown." We have never seen larvae taken in Maine.

Fig. 6.

Pupa—"White except the eyes and mandibles which show red or black through the pupa skin. The head is bent against the breast and the legs folded against the body beneath."

Perfect Insect a small beetle about one-eighth of an inch long, usually polished black. The wing covers marked with longitudinal rows of pits. The thorax irregularly pitted with smaller depressions than those on the wings. The body stout. The legs brown.

Mr. Saunders says this insect is about three-tenths of an inch long. Out of sixteen specimens measured none exceeded 3.5 mm., and most were only 3 mm. or about one-eighth inch long.

He says: "pale in color—sometimes dark" having the wing covers spotted with black. Out of sixteen we mounted at random all are entirely black on the wing covers excepting one which had brownish elytra bearing *four* black stripes, two on each wing cover as shown in Mr. Saunders figure which we give above. We would think the reverse of Mr. Saunders' statement– usually black, sometimes pale—would be more nearly correct. Prof. Forbes in his Second Report, page 161, says: "In the lighter specimens the ventral segments and *three* spots on each elytron are black. Whether these variations in color are due to age, sex or food we do not know. It is evident that some careful work is still needed upon the habits and transformations of this insect. The eggs so far as we know are not known, nor the place of deposition. It is probable that these beetles hybernote, and the pupa that spring, but spent the winter in the beetle form about the roots of the plant.

Remedies.

Should the beetles crawl up the canes before the buds start or after the leaves unfold and before the fruit is formed spraying with Paris green would prove effectual.

Should they appear after the leaves and fruit are formed, as is usually the case, then it would be unsafe to use Paris green, and hellebore would have to be used.

Mr. Bray's experience would indicate that Paris green is not efficient. Certainly one pound to fifty gallons ought to kill them. A repellant or an insecticide that would injure the insect would have to be applied.

As the beetles probably hybernate it would be well to clean up all rubbish about the canes that would afford them winter shelter.

Hand picking though slow may have to be resorted to to check them.

THE CUCUMBER FLEA-BEETLE.

Crepidodera cucumeris, Harris.

Order Coleoptera. Family Chrysomelidae.

A small black beetle about one-sixteenth of an inch long. The antennae and legs are yellow. The hind pair large and strong and adapted for jumping. Very abundant in Maine, early in the spring upon various garden plants, eating small holes in the leaves. It was reported as feeding upon petunias. The beetles spent the winter under rubbish or stones and are ready to attack the earliest plants. The larvae are said to live on the leaves attacked. There are several broods during the summer. The beetle enlarged is shown in Fig. 7. The short line at the left shows the real size.

Fig. 7.

Remedies.

Sprinkle the leaves with hellebore powder or Paris green mixed with fifty parts of flour or plaster. Air-slaked lime or even ashes are said to be good remedies.

THE CURRANT FLY. GOOSEBERRY FRUIT FLY.

Epochra Canadensis, Loew.

Order Diptera: Family Trypetidae.

Bibliography.

Loew—In Smith. Miss. Colls. 256. Monographs of the Diptera of North America Pt. III, p. 235, December 1873. Original description under the name *Trypeta Canadensis*, n. sp. from a Canadian or Maine specimen. *Epochra* is suggested as the more proper generic name. The female is described, evidently from a single faded imperfect specimen. Habits not stated.

Saunders—Insects injurious to fruits, 1883, p. 352. "This insect is occasionally found attacking the fruit of both the red and the white currant. In its perfect state it is a small two-winged fly, which lays its eggs on the currants while they are small; the larva enters them while still green, and feeds on their contents, leaving a round, black scar at the point of entry. The affected currants ripen prematurely, and shortly decay and drop to the ground, when on opening them, there wil be found in each a small white grub, about one-third of an inch long, which when mature leaves the currant and probably passes the chrysalis state under the ground." The above is a full statement of Saunders' remarks in Insects Injurious to Fruits, p. 352.

Gillette, C. P.—Colorado Experiment Station, Bulletin No. 19, p. 18, May 1892. Account of its attacking gooseberries in Colorado. That the fly punctures the skin by a sharp ovipositor. The eggs were observed under the skin. The flies noticed ovipositing. The berries soon turn red and drop after being stung and the maggots remain in them for some time after they fall to the ground. The flies captured and identified. But one brood. Gathering the fallen infested berries suggested as a remedy.

Editors Insect Life. Injurious Insects of 1891 in Colorado. Review of above Bulletin, No. 19. Mere mention of the Gooseberry Fruit Fly (*Epochra Canadensis*, Loew.)

Snow, W. A.—Kans. Univ. Quar., Vol. 11, No. 3, 1894, p. 159. "One male (Maine) in poor preservation apparently belongs here. The wing agrees with the description; the stature of the body can hardly be called "short and rather broad;" the scutellum has four bristles.

Loew was in doubt whether the normal number of bristles on the scutellum was four or six. The reddish abdomen is black at the base and on the two distal segments, but this coloring has much the appearance of being the result of dessication." The above is a full statement of Prof. Snow's remarks, which we insert because they may not be readily accessible, and because we refer to them under *Critical remarks.*

History and Distribution.

This species was first considered by Loew in 1873, from a single faded female contributed by Osten Sacken. Osten Sacken's material may have come from Maine, as he gives Norway, Maine, as the locality, the specimens having been collected by S. J. Smith. Loew gives Canada as a locality upon the authority of Mr. Provancher. How long the species had been known before it was described does not appear, but Osten Sacken says it "seems to be common in those regions." If its habit of infesting currants was known in 1873, no mention is made of it. It is next considered by Saunders in 1883. During the intervening ten years its currant infesting habit became known and some attempts were made to determine its life history.

In 1891, Prof. Gillette found it very abundant in Colorado, infesting gooseberries. This being the first authentic account of its infesting that fruit. Prof. Gillette also added many facts regarding the life history as given above.

Prof. Snow in 1894 examined a single male and contributes the fact, that the bristles on the scutellum are four.

Regarding the single male specimens considered by Prof. Snow, (See bibliography above) he gives us the following: "My single specimen of *Epochra Canadensis* is from the Yale collection and I found it among Dr. Willeston's flies. There is no label upon it except "Me." and Dr. W. can give me no farther information."

We find no reference to this insect in the Agricultural and Horticultural Reports of Maine, and if it has done injury heretofore it has not been recorded.

Mr. Z. A. Gilbert says he was formerly troubled by such an insect, but stopped growing currants for a time and then resumed and has not been troubled since. Mr. D. H. Knowlton, Farmington, says his currants have been infested for several years.

Our first knowledge of this insect was in the summer of 1894, when Prof. Jordan called attention to the fact that a large number of the currants in his garden in Orono was dropping, and that the fallen fruits each contained one or more white maggots. The only reference found to such a currant insect was the few words regarding *Epochra Canadensis*, Loew, in Saunders Fruit Insects, p. 352.

The serious nature of the injury being a matter of importance, and the fact that the life history was apparently almost entirely unknown led us to seriously begin the study of its habits. We were

strengthened in this resolution after finding that the description given by Loew was drawn up from a single female. We did not then know of Prof. Gillett's observations, which are accurate in the main but general, and we trust the more detailed study we have made will be helpful. We were interested in comparing the life history of this insect with *Trypeta pomonella*, Walsh, which we studied in 1888-9. The experience gained in the study of that insect has aided us very much in the study of this. We studied the larvae and pupae in the summer of 1894, and in the spring of 1895 considered the flies, their eggs, and the method of ovipositing, completing the life history. The following results of our study are humbly given hoping they may contribute to a better knowledge of this injurious insect.

The following data which probably refers to *Epochra Canadensis* lacks sufficient confirmation.

Mr. L. O. Howard informs us that in the notes of the Division of Entomology at Washington are the following facts: "June 15, 1885, package of currants and gooseberries infested with larvae evidently of *T. Canadensis* was received from G. L. Colfax, Washington (State.) The adults were not reared. "July 11, 1892, package of gooseberries infested by what is evidently the same insect was received from D. Thurston, West Ferndale, Washington (State.) The larvae were dead when received.

To gain farther information we addressed a letter to Mr. Thurston and received the following reply.

WEST FERNDALE, WHATCOM CO., WASH., July 7, 1895.

Prof. Francis L. Harvey, Orono, Maine.

DEAR SIR—Yours of July 1st to hand. During the years 1890, '91, '92, I noticed my currants (black, white and red,) also gooseberries badly troubled with the worm you refer to. In '93 I was at the World's Fair and could make no observations. In '94 I did not notice any, (my attention not being specially directed to the subject.) This season, '95, at your request I have just looked over my small fruit and failed to find a single specimen! although in the years referred to they were so abundant as in '92 to spoil one-third of the gooseberries and black currants. The only reason I can give for the change, is that for the past few years, I have allowed the young chickens to run at large in the berry patch, and during fall, winter and early spring I allowed the large fowl to run at large also, and they may have exterminated the larvae after they had reached the ground. When I pick the crop if I find any wormy specimens I will forward them.

I remain yours truly,

A. W. THORNTON.

We addressed a letter to Prof. James Fletcher regarding its occurrence in Canada, and below is given his reply.

My Dear Prof. Harvey.

Your letter of July 23rd has been forwarded to me. The only place in Canada, from which I have received complaints of *Epochra Canadensis* is British Columbia, where I am told that in many places the black currants are rendered unusuable owing to the numbers of white maggots which came to the surface when these are cooked. This is presumably *E. Canadensis* although I have been unable to secure any specimens. I have received complaints concerning them for the last thirteen years. At one place, Cowichan on Vancouver Island, I was told in 1885 that black currants could not be used at all on this account.

I have been unable to find any specimens in gooseberries, although the large handsome fruit of *Ribes Lobbii* (a gooseberry) is certainly attacked by some larvae on Vancouver Island.

Regretting that I am unable to give you more information.

Believe me to be yours truly,

J. FLETCHER.

Mr. Wm. Cann of Topsam, Maine, writes us that his curants in 1895 were stung and a maggot was formed inside. No specimens were sent, but it was probably the above insect.

From the above data it is quite certain that *Epocha Canadensis*, Loew, is a native American species, distributed throughout the northern part of the United States, and in Canada, extending from the Atlantic to the Pacific coast. It will be interesting to determine whether it infests native currants and gooseberries and from them has transferred it depredation to the cultivated varieties.

Observations—How Does the Fly Oviposit.

She runs over the currant in a nervous restless manner keeping the wings in a constant fanning motion. Often examines carefully several currants before finding one to her fancy. Usually one of the large currants in the upper part of a bunch that is in the shade is selected. Then coming to rest the last three segments of the abdomen are turned at quite an angle forward under the abdomen. The hind feet are set bracing backward and outwards. Then the truncate end of the last segment rests on the currant and the ovipositor is protruded making a puncture. The probing continues very rapidly for fully five minutes at least, a plunge is made in every second. The last segment is occasionally raised during the process showing the protruded sheath of the ovipositor and the ovipositor inself. Finally the plunging motion changes to a vermicular movement of the abdomen to expell the egg which lasts about half a minute when the ovipositor is withdrawn, and the deed is done. The

mouth parts are constantly in motion during the process. But one egg is laid in a place.

Nature of the Reproductive System.

We dissected several females and found the ovaries double. The eggs giving the abdomen a swollen appearance and filling the abdominal cavity. The egg masses consisted of about ten chains of eggs on each side, each chain in about ten stages of development, making the possible number of eggs the flies are capable of laying fully 200.

The developmental stages are strikingly like those of *Trypeta pomonella*, figured in our 1889 Report, and as in that insect the egg laying period must extend over considerable time.

When Do the Flies Emerge.

Specimens kept in jars in a warm room began to emerge the last week in April, but in nature were first noticed about June first. They were mating at that date and punctures on the currants were abundant indicating an earlier emergence than June 1st. The time varies with the season and locality. No flies were seen in 1896 before June 5th.

How Long Do They Continue on the Wing.

Specimens were quite abundant about the first of June, were most abundant from June 9th to 15th, and by June 25th more were to be seen about the bushes. Making allowance for difference of time of emergence the period of flight would not be over a month at the longest.

What Is the Nature of the Puncture.

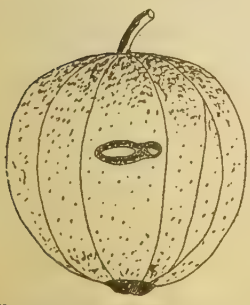


Fig. 7-a. Currant showing the relative position of the puncture and deposited egg.

It is scarcely visible at first but soon becomes surrounded by a brown areola and then is shown to be nearly circular and about a half mm. in diameter. Extending from it at one side is a narrow portion of the epidermis from which the sub-epidermal cells have been removed by the ovipositor, giving it a semi-transparent appearance through which the egg can be clearly seen close under the skin to one side of the puncture.

This portion of the epidermis covering the egg soon becomes whitish, opaque and sunken. We were at a loss at first to know how the egg could be deposited so close to the skin at one side of the puncture but a study of the pro-

truded ovipositor shows that it turns backward at right angles near the end, so that the egg is inserted at an acute angle backwards to the position of the last segment of the abdomen during the deposition. An examination of Plate I, Fig. 9, which shows the protruded ovipositor will make this plain. The end of the egg opposite the pedicel is the one inserted first as shown by the eggs in the oviducts and the position of the deposited egg to the puncture. It is from this end that the larva emerges. We have in this species another instance of deposition of the egg under the skin of the fruit by means of a sharp ovipositor, as in *Trypeta pomonella*, Walsh.

Egg Laying Period.

The eggs are laid one in a place occupying about five minutes for the deposition. The insects are capable of laying fully 200 eggs. The time they are on the wing is about three weeks. This would require that several be deposited each day. An examination of the ovaries showed that about two eggs of each chain or about twenty were practically perfectly developed. The short life period would require rapid maturation of the eggs. If ten were laid each day three weeks would be required to complete ovulation. They may be deposited even faster than this.

The Flies Single Brooded.

Specimens of the pupae taken from the ground under the bushes, about the time the currants were mature, remained in the ground in a warm room all winter but did not emerge until April. Those in nature emerged about June 1st. The insect therefore spends about eleven months of the year in the ground.

How Long Does It Take the Larvae to Mature.

The larvae began to emerge June 20th. An examination of many currants at that date showed that quite a per cent contained full grown larvae. The deposition of eggs began about June first which would indicate three weeks as the time required for full growth. As we found at this date larvae from two mm. to seven mm. in length it would extend the time that the fruit is infested from the laying of the first eggs to the maturity of those last laid which would be fully six weeks. Our observations indicate that the larvae do not leave the fruit as soon as matured which would extend the time still farther. We had some larva pupate as late as July 15th.

Nature of the Work of the Larvae.

When hatched the larva is about one mm. long and as soon as it emerges from the egg begins to travel, often leaving a delicate light colored trail close under the skin which can be seen through it. This is not always the case. After traversing from a third to a half the distance around the currant it locates, entering in most cases one of

the seeds, disappearing entirely within it. Sometimes the larva locates near the puncture and sometimes the exit hole is on the opposite cheek from the puncture. As it grows the head finally protrudes from the seed as shown in Plate I, Fig. 7. After feeding upon the contents of a seed and having grown too large to find lodgment within it, it locates between the seeds in the pulp and then gnaws holes in the seeds eating the contents of one after another until often the contents of at least half a dozen are consumed before the larva is grown. They seem to reject the coats and the clear gelatinous envelope that surrounds the seeds. The refuse of the seeds eaten turns black and becomes cemented together. A black spot becomes visible through the skin. The location of the larvae can be told readily as the currants infested soon begin to show a clouded appearance where they are located. That cheek turns red earlier and rapidly a deeper red and finally a black spot. Infested fruits ripen earlier. Often half grown larvae will be found with the head end half buried in a seed. Finally when full fed the larvae gnaw to the surface and cut a circular hole about 1.5 mm.d. through the epidermis by means of which they emerge with ragged edges.

Do the Currants Drop While the Maggots are Still in Them.

On June 22nd we collected several hundred currants that had fallen on the ground. One hundred of them were carefully dissected and every one contained a maggot excepting two from which the maggots had emerged leaving the evidence of their work. (We put about two hundred of the currants in a box and on June 24 twelve pupae were found.) The maggots were of various sizes from 2.5 mm. to 7 mm. showing that the currants often drop before the maggots are mature. On the same date we took quite a number of currants from the bushes that were turning red. They were the large ones at the base of the bunches and invariably were infested by a maggot. The maggots were of various ages, some full grown, but would not average as large as those found in the currants on the ground.

Do the Larvae Leave the Fruit as Soon as It Falls.

An examination of currants picked from the ground under the bushes contained larvae of various ages, 7 mm. 4 mm. 3 mm. and 2 mm. in length.

Put quite a number of infested currants in a box June 22nd and some of them did not emerge and pupate before July 15th. The most however emerged in five days.

Quite a number of currants were found on the bushes containing evidence of aborted work showing some mishap to the egg or developing larvae. There were others which showed an exit hole proving that quite a number of the maggots drop to the ground from the currants before they fall. Quite a number of currants showed more than one egg puncture and several from two to three live and flourishing larvae.

Are All of the Fruits in the Bunches Affected.

The inflorescence of the currant is racemose and the fruits at the base develop first and are first in condition to receive eggs. In these the earliest laid eggs are placed. The currants at the ends of the bunches were exempt and ripened good fruit after the flies were done ovipositing.

Where Does the Insect Spend the Winter.

When the larvae are ready to transform they crawl out of the currants and enter the ground a short distance if it is suitable, or they may transform on the surface under rubbish. They may be found in abundance in the ground under the bushes in the fall. The larval skin is not cast but the larva shortens up becoming a coarctate pupa of a pale yellowish brown color. In this condition the insect spends eleven months of the year gradually undergoing changes into the fly which emerges the following season.

General Description.

Perfect insect a two-winged fly about the size of a house fly. Pale yellow or orange with greenish iridescent eyes and dark bands across the wings. Found about currant and gooseberry bushes during June in Maine. Stings the currants, depositing an egg under the skin, that hatches and develops into a small white maggot causing the fruit to turn red and drop prematurely. The maggots when grown leave the fallen or hanging fruit, enter the ground, change to the pupa state from which the fly emerges the following June.

Technical Description.

Female Fly—Pale clay-yellowish or in darker specimens pale orange. On the border of the front on each side, are three or four long, but rather weak black bristles which curve toward each other. Between the ocelli and the last bristle on the border of the front is a single bristle that curves toward the vertex. On the vertex near the eye two bristles the inner much longer. Antemae darker yellow than the head, third joint rounded at the tip; arista blackish, yellow towards the base, with a very short pubescence. Rostrum and palpi pale yellow, the latter not reaching beyond the anterior edge of the oral opening. Thoracic dorsum with a very thin, whitish bloom, a double middle stripe and a narrow lateral stripe, rather shining and somewhat darker than their surroundings. The posterior end of the thoracic dorsum and the scutellum, shining, very pale yellow; a not very broad yellowish stripe runs from the humeral corner to the root of the wings. The scutellum convex and not very large; bristles on the scutellum four. The bristles of the thorax and of the scutellum,

as well as the short pile of the thoracic dorsum, are black. Metathorax distinctly infuscated on its superior margin and its middle line. Abdomen shining, with short black pile; the fourth and fifth segments marked by a chestnut brown or black cross band interrupted in the middle, the third usually and sometimes the second segment with a lateral beginning of such a stripe indicated by a chestnut-brown or black spot. Pale specimens without abdominal markings excepting upon the long seventh which in all specimens is dark on the proximate dorsum and at the distal end. Seventh segment equal to the three preceding segments taken together, very broadly truncate and infuscated at the end.

The seventh segment contains the retractile sheath of the ovipositor and the ovipositor. The sheath is clyindrical,broadest at the ends. Clothed with retrorse scales arranged in six longitudinal bands at the base which are brownish toward the end and becoming black near the base. Toward the end the scales become smaller and cover the whole surface, and at the middle the six bands are merged into four.

The ovipositor provided with two guides which are flat, obtuse at the ends and extend three-fourths its length. The ovipositor brown, flat, serrate on the edges, each edge with three teeth. The basal tooth remote. Both faces of the distal lateral teeth each bear two rows of five black bristles. See Plate II. The tip pointed. The principle is that of a double edged serrated hay knife or a *Crysty Bread Knife*.

The front femora are sparsely beset with bristles upon the upper and under side; the middle femora are entirely without bristles; upon the hind femora, likewise, there are only a few bristle-like hairs before the end of the upper side; the upper side of the hind tibiae is merely beset with exceedingly short bristle-like hairs. Wings of the usual shape, hyaline, with a pale-brown picture or in darker specimens nearly black; it consists: 1. In an oblique half cross-band running from the humeral crossvein to the basis of the second basal cell; 2. Of a crossband parallel to the first, abbreviated behind, which begins at the stigma, near the anterior margin, and runs across the basis of the submarginal cell, as well as across the cross veins, which close the second and third basal cells, and thus reaches the sixth longitudinal vein; 3. Of a rivulet which begins above the posterior crossvein, near the third longitudinal vein, runs from it across the posterior crossvein as far as the posterior margin, is continued along this margin inside of the third posterior cell, but, before reaching the sixth longitudinal vein, is suddenly turned upwards, running parallel to the band which begins at the stigma, crossing the small crossvein, and thus reaching the anterior margin, where, gradually expanding, it forms a border ending a little beyond the tip of the fourth crossvein. The two cross-bands as well as the rivulet, are of moderate breadth only; the latter has, in the described specimen, the following faded spots, which, in more fully colored specimens, are probably less apparent or alto-

gether absent. 1. A rounded spot in the marginal cell, above the origin of the rivulet; 2. Upon the longitudinal axis of the submarginal cell an indentation in the inner margin of the section bordering the apex of the wing; 3. Upon the longitudinal axis of the first posterior cell an interruption of the rivulet at its origin and an indentation in the inner margin of the portion bordering the apex of the wing; 4. Upon the longitudinal axis of the discal cell a narrow interruption of the section, running again towards the anterior margin; 5. The spot upon the posterior margin connects the first, descending, portion, with the second, which rises again upwards. The first and third longitudinal veins are bristly; the third and fourth are parallel towards their end, both very gently curved backwards; the section of the fourth vein preceding the discal cell is gently, but rather distinctly arcuated backwards, so that the shape of the discal cell somewhat reminds of that of the species of Rivellia; the crossveins are comparatively rather long, moderately approximated, their distance being about equal to the length of the posterior crossvein; the latter is rather steep, however, perceptibly approximated to the apex with its anterior end, more than with the posterior; the posterior corner of the anal cell is very much drawn out in a point.

Male Fly—Pale clay yellow to pale orange. Smaller than the female and the color and wing picture the same but paler. The head and eyes as in the female. In front view about as long as broad with mouth up, anterior distance between the eyes only half as great as the posterior. The three ocelli brownish. Three long, weak black bristles upon the border of the front as in the female. On the occiput just above the neck are two clusters of six black hairs each, that lie parallel to each other. The antennae darker yellow than the head. The terminal joint twice as long as broad, rounded at the end and not reaching the mouth. Palpi and rostrum yellow the former not reaching beyond the mouth. Arista black, pubescent yellowish at the base.

The thoracic dorsum bears a faint double median stripe and also a narrow lateral stripe. The pollinosity in our specimens seems to be continuous over the whole surface and not absent from the stripes as described by Loew. The entire thoracic dorsum covered with short black hairs excepting the posterior portion. The scutellum is naked excepting that it bears *four long black bristles*. Post border of scutellum dark colored and together with a median dark stripe on the posterior metathorax makes a T shaped marking. Sides of thorax armed with five long black bristles. Four shorter weaker hairs on anterior of thorax. Halteres pale.

Femur of the anterior pair of legs armed with long black bristles. Femur of other legs unarmed. The two posterior legs darker. Abdomen oblong, arched, width to length as 5:8. Composed of six segments, ratio 3:4:4:4:5:2. The basal bears an obscure median dorsal brown spot. The posterior portion of the abdomen darker yellow.

Fourth and fifth segments each bear an obscure brown spot on the lateral dorsum. Part border of the narrow sixth segment dark brown but usually turned under the abdomen so that from above the end of the abdomen appears yellowish. There is a row of ten long bristles on the posterior border of the fifth segment (see Plate I, Fig. 10.) Attached to the lower surface of the sixth segment is the external genital apparatus composed of claspers, guide and penis. The claspers are club-shaped and notched near the posterior end on the interior edge. The guide between the claspers is a horse hoof shaped organ half as long as the claspers ending in a tuft of hairs and backward narrows into a small pedicil. The penis is exceedingly long, bearing at the end an enlargement to which is attached a pedicilate pear-shaped appendage. See Plate I, Figs. 8 and 10.

The wings as in the female.

Measurements of Male Fly.—Total about 6.5 mm. Head .931 mm. long, depth .1064 mm. exclusive of rostrum, breadth 1.729. Width of eye from dorsal view .399 mm. Front view nearly round, about .745 mm. with mouth up anterior distance between eyes .675 mm. posterior, 1.33 mm. Arista 2.93 mm. Thorax 2.13 mm. long. Abdomen 3.46 mm. long, 1.33 mm. wide. Segments in the ratio 3:4:4:4:5:2.

Eggs—Opalescent white, oblong, pedicelate. The pedicelate end more pointed than the other which is somewhat obtuse. The pedicel with a short narrow neck and bulbous at the end. The pedicelate end for about one-third of the length sculptured by raised lines arranged in a hexagonal pattern giving a rough pitted surface, most conspicuous near the pedicel and gradually lost in the smooth surface of the opposite end, about four and a half times as long as wide. They measured 1.064 mm. by .24 mm. in one specimen and 1.04 mm. by .25 mm. in another. (Plate I, Fig. 2.)

Larva—Length 7 mm. (.28 in.); breadth 1.5 mm. (.06 in.) White with sometimes a faint rosy tint, probably due to absorption of the colored juice of the currant. Footless body composed of about thirteen segments. Widest in the middle, tapering rapidly toward the head, which is small, pointed and emarginate. (Plate I, Fig. 3.) The mouth circular surrounded by a zone of ridges and furrows. From the mouth protrudes two curved parallel retractile black hooks, the *rasping organs* of the larva, by means of which it gnaws the fruit. (Plate I, Fig. 6.) The chitinous frame work to which these hooks are attached shows as a black area in the second and third segments. These hooks and frame work give the end of the head a black appearance. There are two pairs of tubercles upon the front of the first segment. The lower pair smaller. (Plate I, Fig. 6.) The cephalic and candal spiracles are yellow. The former between the third and fourth segments and lacerate funnel formed. The latter are on the posterior face of the last segment and end in three finger like thorns. (Plate I, Fig. 5.) These are connected by trachea with large anastomosing branches at the posterior and anterior ends. The larva when first hatched is about 1 mm. long, and slender

This larva looks much like that of *Trypeta pomonella* and could not be separated without a hand glass, but the mouth, head and candal spiracles are quite distinct.

Pupæ—Five mm. long by nearly 2.5 mm wide, broadly oblong, straw colored, coarctate. The head end more pointed and showing the cephalic spiracles. The candal spiracles also apparent. In emerging the fly breaks away the lower half of the first four cephalic segments. The pupa is shown in Plate I, Fig. 4.

Critical Remarks.

Mr. Loew says in the introduction to Part III of his "North American Diptera" (Smithsonian Miss. Colls. p. 213) I have been compelled to draw the descriptions of several species from single, often badly preserved specimens, and I am afraid that these descriptions * * * may sometimes betray the incompleteness of my material." Appreciating this fact the critical remarks made below are not given in the spirit of a criticism but to supplement what has been written after the careful examination of an abundance of material. Loew must have examined faded or pale colored specimens as the larger and better developed individuals have the abdominal markings dull black and also the markings on the wings are much too dark to be described as having "a pale brown picture." There are occasionally females with slender abdomens which are without markings. These seem to be *unimpregnated* or possibly through ovipositing. The intensity of the color in others is variable. There is a dark uninterrupted band across the posterior border of the sixth segment. Loew calls the last abdominal segment of the female the ovipositor, a mistake which entomologists made in regard to *Trypeta pomonella*, Walsh. The last abdominal segment is about as long as the three preceding, conical, truncate at the end, and retracted within it are sheath and ovipositor. Mr. Loew evidently did not see the ovipositor which we have described and figured. (See Plate II.) He also makes a mistake regarding the number of abdominal segments, there being *seven* the one at the base having been overlooked. Therefore, the description given by Loew, "the third and fourth segments have, each at its basis, a chestnut cross band interrupted upon its middle, while upon the second segment only a lateral beginning of such a stripe is indicated by a chestnut brown spot," would have to be corrected by saying fourth and fifth and third segments respectively. Mr. Loew is in doubt regarding the number of bristles upon the scutellum, which we find is four upon *both* male and female. In the brighter colored flies there is a decided orange tint, which would require a modification of the statement that the color is "pale clay yellowish." We find that the number of bristles on the border of the front is usually three on each side; but it varies from two to four. In some specimens three on one side and four on the other. Mr. Emerton's drawing (Plate I, Fig. 1) shows four.

Saunders says it "lays its eggs on the currants while they are small." Our observations are that the eggs are inserted under the skin through a small hole made by the sharp ovipositor, and that the currants are quite large before the eggs are laid, and that the largest ones at the base of the bunches are usually selected first. He also makes a mistake when he states that the larvae leave "a round, black scar at the point of entry." The young larvae usually travel some distance from where the egg is deposited before establishing headquarters. The black scar locates the larva, and results from the decomposition of the parts injured and the exuviae of the larvae. The *exit* hole of the larva is usually located in the black scar. The puncture made to lay the egg is too small to be noticed excepting by close examination. He also says the insect "probably passes the chrysalis state in the ground, a guess which is confirmed by finding the pupae in abundance in the ground under the bushes.

Prof. Snow correctly doubts that the abdomen of the male is "short and rather broad," but the black of the abdomen in well colored specimens is natural. The abdomen of the female varies from very narrow in unimpregnated specimens or those through depositing to every broad in those full of eggs. The abdomen of both shrivel and change form in drying, and the colors are duller. The abdomen of the male has but six segments, and from that reason is shorter than that of the female though the segments preceding the sixth are larger than those of the female.

We are at a loss to know how Prof. Snow can arbitrarily "consider six as the number of segments composing the abdomen of the female trypetid and five as composing that of the male," when nature has decided the matter by giving the former seven and the latter six. Certainly it can lead to nothing but confusion as has Loew's discrepancy in the correct number. We can't even see any good reason for longer perpetuating the error that the long terminal abdominal segment is the ovipositor, for it certainly has nothing to do with depositing. It is not inserted at all into the puncture and merely has the ovipositing apparatus attached to it and when not in use telescoped within it. The fine plate which we give of the ovipositor from the pen of Mr. Emerton should settle this matter.

There are also six well defined segments separated by sutures in the male abdomen in front of the external male genitalia as shown in Plate I, Fig. 10. The terminal segment is, however, short.

Prof. Gillette's observations of the habits of this insect agree with ours very nearly, though he studied its work upon gooseberries instead of currants. We are, however, of the opinion that the currants stung remain on the bushes much longer than he records for gooseberries, and that the red spot develops where the larvae is located instead of where the egg is deposited. In currants the egg is not laid in the pulp, but at one side of the puncture close under the skin, so it can readily be seen through it.

The figure of the fly given shows but four abdominal segment, anterior to the long terminal one while there are really six. The thorax dorsum is not of uniform color as shown, but is faintly double striped down the middle and at the sides by the absence of the whitish bloom that covers the upper surface. See Plate Fig. 1. The thorax is too long and the head too narrow and small.

We find that quite a number of the maggots leave the currants before they drop. This may not be so with gooseberries. For currants we can not recommend gathering the fallen fruit as only a partial remedy.

Remedies.

We have had no experience with this insect as it is new to Maine as an injurious species. From a study of its life history we discover only one vulnerable point. The insect spends eleven months of the year in the ground and can not be reached. In the winged stage it cannot be destroyed so far as we know. The eggs are deposited under the skin of the fruit and spraying would do no good. *Part of the infested fruits drop prematurely and the worms remain in them for some time before they emerge and go into the ground.*

(a) Based upon this last habit we would recommend gathering up the fallen currants frequently and burning them.

This remedy cannot be relied upon to destroy *all* the flies as quite a number of maggots leave the fruit before they fall. It can be depended upon to destroy fully half if not more and can be employed to keep them in check.

(b) As these flies are weak and liable to perish if any obstruction is offered to prevent their coming out of the ground, we would recommend a mulching of coarse straw or hay, several inches deep, placed under the bushes and out as far as the branches extend, and well packed.

(c) As the larvae find fine dry dusty substances prejudical to their transformation a heavy dressing of coal ashes placed under the bushes in June would destroy many of the larvae and also prevent the flies from emerging the following spring. Prof. Jordan tried this on his garden without flattering results.

(d) Our western correspondent Dr. W. A. Thornton thinks that allowing young chickens about the bushes early in the season and large fowls later after the fruit is gathered will keep them in check.

(e) A radical remedy would be to pick and destroy the crop after the eggs are largely laid and before the currants drop, or pick the entire crop while green and before the flies appear. If there are no currants of course no eggs could be laid, and the flies would have to go elsewhere or perish.

(f) As the pupae are found only about an inch below the surface, they could be destroyed with little trouble by removing the soil to that depth from under the bushes and burying it deep or depositing it on a road or some exposed place.

(g) We have not discovered any parasites to help check the pest. Short bearing years would tend to reduce the numbers.

Fig. 1.

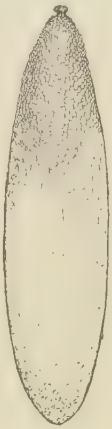


Fig. 2.

Fig. 4.

Fig. 5.

Fig. 3.

Fig. 8.

Fig. 7.

Fig. 6.

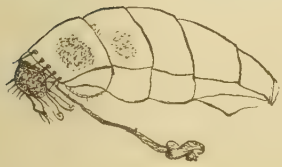


Fig. 10.

Fig. 9.

The Currant Fly, Gooseberry Fruit-Fly.
(Epochra Canadensis, Loew.)

EXPLANATION OF PLATE I—THE CURRANT FLY.

(*Epochra Canadensis*, Loew.)

All excepting Figure I were drawn by the writer.

Figure 1. The female fly enlarged about seven and a half times. Drawn by Mr. J. H. Emerton from slides of the wing and ovipositor prepared by the writer and from pinned flies. The two basal joints of the abdomen are drawn as one. The real number, including the long terminal segment is seven instead of six.

Figure 2. Egg showing form, sculpture and pedicel, enlarged fifty times.

Figure 3. The larva enlarged about five times.

Figure 4. The pupa enlarged eight times.

Figure 5. The candal spiracle of the larva much enlarged.

Figure 6. First two segment of the head showing the tubercles on the head, the rugose mouth and the rasping organs. Enlarged twenty-five times.

Figure 7. Seed of currant with gelatinous envelope showing larva protruding from it. Enlarged.

Figure 8. External genitalia of male. Enlarged twenty times.

Figure 9. Side view of abdomen of female with ovipositor protruding and bent backward in the position it takes as the egg is deposited under the skin to one side of the puncture. Enlarged.

Figure 10. Abdomen of male with gentalia and showing six segments. Enlarged.

EXPLANATION OF PLATE II—THE CURRANT FLY.

(*Epochra Canadensis*, Loew.)

This plate prepared by Mr. J. H. Emerton from dissections made by the writer, shows the end of the last abdominal segment; the sheath of the ovipositor; the guide; the ovipositor; the bristles terminating the abdomen; the triangular scales that point backwards and cover the most of the sheath; the teeth upon the ovipositor and the small bristles near the end.

When not in use the ovipositor and guides are telescoped into the sheath and the sheath into the long terminal abdominal segment. The figure is enlarged one hundred and twenty times.

The Currant Fly, Gooseberry Fruit-Fly.
(*Epochra Canadensis*, Loew.)

NOTES ON THE INSECTS OF THE YEAR.*

F. L. Harvey.

Woodlouse or Sow Bug, a crustacean belonging to the genus Oniscus, was reported as doing damage in mushroom cellars by eating the fungi. They can be killed by putting pieces of potato poisoned by a solution of arsenic in the beds.

Croton Bugs were received from Monmouth, Me. These no doubt were introduced in packing materials. This insect is quite abundant in some towns in the State. It is an importation from Europe. They frequent houses especially about water pipes. Free use of insect powder scattered where they frequent is said to destroy them.

The Oyster-shell Bark-louse is exceedingly abundant and is increasing rapidly. As it saps the vitality of trees without attracting much attention, it is overlooked. It seems to thrive better in the North, being worse in Maine than farther south. It does more injury to young trees. We have received information this season of orchards of young bearing trees so badly infested that the twigs of all the trees were literally covered with the scales. The life history of this scale is given in the Report of this Station for 1888, p. 157, but we wish to add the following regarding treatment. The usual way is to apply a dilute alkaline wash to the trees in the spring after the young lice hatch. These scales could be treated in the winter at any time by applying thoroughly to the trees and small branches with a brush a *strong* alkaline wash, made by dissolving two pounds of whale oil soap in one gallon of water. The cost of the material would be more for the strong wash, but there is more leisure in winter to do the work. The strong wash should not be applied after the leaves start.

* Taken from the Maine Agricultural [illegible]
Entomology No. 11.

The Hemispherical Scale was found quite abundant upon ferns grown in the house at Orono. It is also found on ferns in the Station forcing house. It yields readily to treatment with alkaline or kerosene alkaline solutions.

The Elm-Tree Bark-Louse considered in the Report of this Station, 1894, page 83, was reported again this season as abundant on elms.

The elms in Maine are also infested with Canker Worms, Mourning Cloak Butterfly, The Oak-bark Weevil and the Steel-Blue Flea Beetle, (*Haltica chalybea.*)

The Buffalo Tree Hopper was reported this season for the first time as doing damage to the foliage of apple trees. It is pale grass-green in color, marked with whitish dots and a pale yellow streak along each side. It is an active, jumping insect. The form and size are shown in the accompanying plate, Fig. 1.

The Yellow-necked Apple-tree Caterpillar was reported this season for the first time as feeding on the foliage of apple trees. The small white round eggs of this insect are laid side by side in nearly straight rows on the under surface of the leaves. The young larvae eat only the pulp of the leaves. When older they devour all but the stem, destroying all the leaves on a branch. The full grown caterpillars are about two inches long. The head is large and black. The joint next to the head is dull orange. There is a black stripe down the back and four yellow stripes down the sides, alternating with three black ones. Body clothed with soft whitish hairs. Fig. 5 shows the caterpillar in the position it assumes (with the head and tail up) when disturbed. Though partial to apple trees, it attacks plums and pears and several kinds of deciduous trees. It is capable of doing great damage when abundant. The larvae feed together and the branch on which they occur can be cut off or the clusters of insects crushed.

The Fall Canker Worm so abundant for several years has not been abundant the past season, though doing some damage in southern and western Maine.

Fig. 1.

Fig. 2.

a *b*

Fig. 3 a & b.

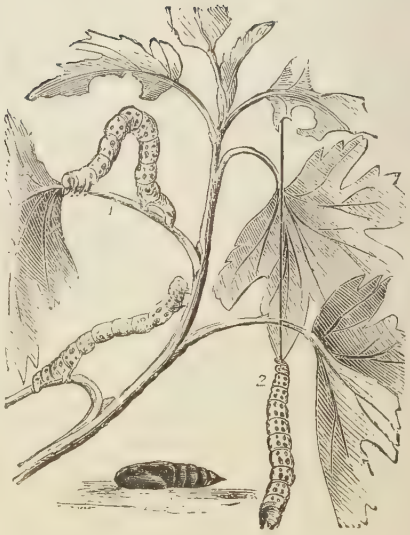


Fig 4.

Fig 3 c.

Fig. 5.

Fig. 6.

Fig. 7.

The Currant Span Worm is very abundant about Orono. Our attention was called to currant and gooseberry bushes almost barren of foliage from the attacks of this insect. It is very different from the Currant Sawfly worm, which is so common in Maine. It is the larva of a geometrid moth, and has the habit common to inchworms of arching the back when crawling. When full grown it is about an inch long, whitish in color, with a yellow stripe down each side and another along the back. The segments are spotted with black. There is but one brood in a season. The larvae have the habit of suspending themselves with a silken thread when disturbed. Fig. 4 shows the larvae, pupa. The moth is shown in Fig. 2. Hellebore will not destroy this insect. Paris green would be effective, but the worms are worst when the fruit is nearly grown. Possibly a strong wash of whale oil soap and water applied in the winter might destroy the eggs which are deposited on the twigs and branches.

The Gooseberry Fruit Worm seems to be on the increase. It is common on the wild gooseberries in Maine and may spread from this source. This worm is the larva of a small moth which is shown in Fig. 3 b. The cocoon is shown in Fig. 3 a. The larva, Fig. 3 c. The moth deposits its eggs upon the young berries and the worms gnaw into the fruit. As they grow, several berries are enclosed in a web, and the worms live on them. Infested berries ripen prematurely. When disturbed, the worms let themselves down quickly by a thread, which makes it difficult to destroy them by hand picking. Rubbish should be removed from under the bushes where the insect hibernates.

The Lime Tree Winter Moth was reported this season in injurious numbers. It seems to remain where the Fall Canker Worm has about disappeared. It was considered and figured in the Report of this Station, 1893, page 161.

The Army Worm made its appearance in limited numbers at Corinth. Mr. W. E. Jordan, who sent us specimens, reported it as feeding on oats.

The Ash-gray Pinion was reported again this season as eating into apples. This species is figured in the Report of this

Station, 1888, page 176. The larva of *Pororgia Clintonii* was reported from Aroostook county as feeding on the foliage of apple trees.

The Velleda Lappet Moth. This insect was received from Western Maine where it was mistaken for the Gypsy Moth. This species having never been reported before from Maine we give cuts of the moth and larvae.

The body of the larva is covered with warts, which bear tufts of black hairs. On the back and at the sides, gray hairs are mixed with the black. When at rest the caterpillars lie close to the twigs and are hard to see. The flat under-surface is pale orange marked with black dots. See Fig. 6. The moths are gray and white. See Fig. 7.

The Apple-tree Tent Caterpillar was very abundant the past season in Western and Southern Maine.

The season has been remarkable for the great number of leaf eating insects reported. Besides those noted or found in the list printed above there were several species of budmoths and leaf rollers, that did much damage. These insects could be controlled by spraying, a practice that is gradually coming into favor among fruit growers in Maine, but which could be employed profitably much more than at present.

The Currant Fly (*Epochra Canadensis*) was more abundant than ever the past season about Orono. It is not generally distributed. There are none in the Station garden, though badly infested gardens occur in Orono.

The Apple Maggot (*Trypeta pomonella*), we are happy to say, has nearly disappeared in several localities during the past season where it was very bad before. Whether it has really gone or whether the large apple crop has made it appear less numerous on account of abundant food supply is a question. It is probable, however, that the late appearance of snow for the past two years together with freezing and thawing have destroyed the pupae, which are deposited so near the surface. Flies as a class are fragile and subject to injury by great climatic changes.

Rat-tail Larva, the maggot of a species of two winged fly which has a long tail-like appendage to the body, was received for examination.

These maggots live in water or liquid decaying organic matter. So say the books. The long tube like a tail is used as a respiratory organ. One of the specimens received was taken in chip dirt on the floor of a wood-shed. It would seem that they also live in dry situations and put the tube to the surface of the debris to breathe.

From one of the specimens came a large yellowish brown fly. These flies live on the pollen of flowers and are often seen about flowers during the summer.

The Horn Fly continues to be reported but seems to be on the decrease in Maine.

The Buffalo Beetle is spreading. We have had word of it from several new localities the past season.

The Pigeon Tremex is doing considerable damage to maple and other shade trees in some parts of the State.

Ptinus Fir, a small beetle, was reported as badly infesting a bag of timothy seed. The bag had been hanging in a finished room from May until the following March. When examined, thousands of the beetles were found. This is an introduced species from Europe. Probably a few got in before the seed was hung up, and multiplied.

INSECTS EXAMINED IN 1896.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Wood-louse. Sow Bug	*Oniscus spècies*	B. Walker McKeen from Auburn,	Eating mushrooms in cellar.
2	Cat Tick	*Ixodes crinaceus*	T. D. Morril, North Yarmouth	On domestic cat.
3	Croton Bug	*Phyllodromia Germanica*	Mrs. M. O. Edwards, Monmouth.	In store. Probably brought in packing material.
4	Grape vine Leaf-hopper. Thrips	*Erythroneura vitis*, Harris.	Ora Knight, Bangor.	
5	Oyster-shell Bark-louse	*Mytilaspis pomorum*	A. S. Field, Bangor / Fred S. Wiggin, Maysville	On apple trees.
6	The Hemispherical Scale	*Lecanium hemisphæricum*, Targioni	Eben Webster, Orono.	On ferns in house.
7	Elm-tree Bark-louse	*Lecanium*	C. H. Morrell, Pittsfield.	
8	The Buffalo Tree-hopper	*Ceresa bubalus* (Fobr.)	R. A. King, East Monmouth	On foliage of apple trees.
9	Yellow-necked Apple-tree Caterpillar	*Datana ministra* (Drury)	J. F. Talbot, Andover	Eating foliage of apple trees.
10	Red humped Apple tree Caterpillar	*Œdemasia concinna* (Sm. & Abb.)	F. E. Bixby, Anson	Eating foliage of apple trees.
11	The Fall Canker-worm	*Alsophila pometaria*	Gilman Blood, Foxcroft.	
12	The Currant Span-worm	*Diastictis ribearia*	F. L. Harvey, Orono.	
13	The Gooseberry Fruit-worm	*Dakruma convolutella* (Hübn.)	Mrs. W. H. Davis, West Gardiner,	Attacking the fruit.
14	The Lime-tree Winter Moth	*Hybernia Tiliaria*, Harris.	Gilman Blood, Foxcroft / R. A. King, East Monmouth	Attacking apple trees. / Attacking apple trees.
15	The Army Worm	*Leucania unipuncta*	W. E. Jordan, Corinth	Attacking oats.
16	The Ash-gray Pinion	*Lithophane anthennata* (Walker)	C. H. Davis, Harmony	Eating into apples.
17		*Pororgia Clintonii*	Bagely Bros., Caribou	Larva feeding on apple.
18	The Plum-tree Sphinx	*Sphinx drupiferanum* (Sm. & Abb.)	O. S. Shaw, Winthrop	On apple tree.
19	Fall Web-worm	*Hyphantria textator*, Harris	A. T. Wing, Weld	Pupa on limb of apple tree.

20	The Velleda Lappet-moth. ...	*Tolype Velleda* (Stoll)	C. H. Thompson, Jay.....	Mistaken for gypsey moth.
21	Apple-tree Tent-Caterpillar.	*Clisiocampa Americana*, Harris....	D. J. Bixby, South Turner, and several others.	
22	Luna Moth..... ..	*Tropæa luna*..	S. J. Spalding, North Buckfield.	
23	Cecropia Moth	*Platysamia Cecropia* (Linn.).....	C. Fenderson, Wilton	Cocoon on apple tree.
24	Mourning Cloak Butterfly...	*Vanessa antiopa*, L	C. H. Morrell, Pittsfield.	
25	Rat tail Larva	*Mollota*...	H. W. Goodwin, West Lewiston..	In decaying organic matter.
26	Horn Fly	*Hæmatobia serrata*	J. E. Crocker, St. Albans....	On cattle.
27	Buffalo Beetle...	*Anthrenus Scrophulariæ*, L.....	Isabel F. Hinckley, Bangor, and others	Destroying carpets.
28	Bacon Beetle	*Dermestes lardarius*	B. H. Dunham, Foxcroft	In pantries from May until October.
29	Sugar Maple Borer.	*Plagionotus speciosus*....	Sam. Richards, South Paris	Doing injury to maple trees.
30	.....	*Ptinus fur*	William L. Jackson, Greenfield..	Destroying stored Timothy seed
31	Plum Curculio.	*Conotrachelus nenuphar* (Herbst.).	Chas. Vaughn, Hallowell	Attacking plums.
32	Oak-bark Weevel.....	*Magdalis olyra* (Herbst.)	C. H. Morrell, Pittsfield....	Elm trees.
33	Lesser Grain-beetle...	*Sylvanus surinamensis*, L	N. A. Haskell, New Gloucester ...	Specimens from Massachusetts.
34	Ash Timber-beetle	*Hylesinus aculeatus*, Say..... . .	W. L. Mowyer, Greene.	
35	May-beetle	*Lachnosterna fusca* (Frohl.)	Miss M. Minot, Bar Harbor.....	Feeding on grass roots in lawn
36	Cucumber Flea-beetle	*Crepidodera cucumeris* (Harris). ..	B. W. McKeen, Augusta	On potato leaves.
37	Steel blue Flea beetle	*Haltica chalybea*	C. H. Morrell, Pittsfield..... ..	On elms.
38	Pear tree Slug	*Selandria cerasi*, Peck.....	C. H. Morrell, Pittsfield.....	Eating foliage of pear trees.
39	Blackberry Seed Gall	*Diastrophus cuscutæformis*, O. S ...	E. F. Roundy, Bangor.....	Making gall-like excrescence on black berry leaves.
40	Ichneumon	*Pelecinus polyturator*.....	F. W. Gifford, Dover	About orchards. Probably beneficial.
41	Pigeon Tremex.....	*Tremex Columba*, L.....	S. Richards, South Paris.....	Boring in maple trees

A NEW GARDEN SMYNTHURID.

Smynthurus albamaculata n. sp.

By F. L. Harvey.

Body dull blue-black with steel blue reflections in direct light, obscurely marked with numerous small whitish blotches of variable shape and size, arranged in poorly defined transverse bands, giving a marbled appearance. Head, terminal segments of the body, antennae, legs and elater pale purple. Underside of body pale brownish. Sides of head and the vertex yellowish brown. Eye patches black, bordered on the inner margin by a whitish band which is constricted in the middle giving the appearance of two spots. Antennae more than half as long as the body. Ratio of segments 1:2½:3:5. The basal joint widest, globular and whitish. Base of the second segment light. Terminal segment composed of nine joints. (In young specimens apparently eight jointed by the coalescence of the two terminal). Antennae, legs, elater and body clothed with hairs. Body widest behind, abruptly narrowing into the terminal segments. Anal tubercles prominent. Claws medium size. The larger, .031 m. m. with a single tooth on the inner edge near the end. Short claw, .017 m m. plain, broadest in the middle. Two tenent hairs about the length of the longer claw and extending about two-thirds the length of the claw. Furcula short and stout. Ratio to body 4:7. Ratio of parts of furcula: manubrium 4, dentes 4, mucrones 1. Dentes with about ten bristles on the lower edge. Mucrones curved near the base, narrow lanceolate and plain. Length of insect .8 to 1.4m m.

Habitat:—Found abundantly during May and June in gardens. Doing much damage to early garden plants. Attacks radishes, beans, cucumbers, squashes, etc., eating numerous holes in the epidermis of the leaves and sucking the

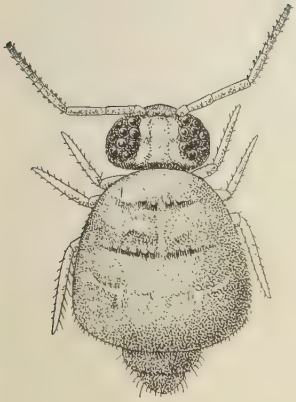


Fig. 1.

Fig. 3.

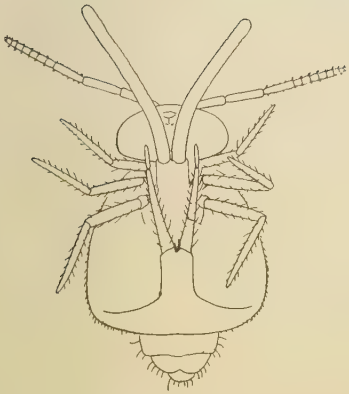


Fig. 2.

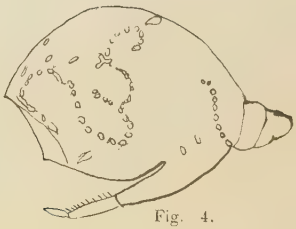


Fig. 4.

Fig. 5a

SMYNTHURUS ALBAMACULATA, Harvey.

juices until the leaves wither. Numerous specimens examined during the last five years. Orono, Me., F. L. Harvey.

Distinguishing characters:—This species has the same habits as Fitch's *S. hortensis* and is equally as injurious. For a long time we took it for that species. It has the dark body and lighter head, legs, antennae and elater of the above. It is, however, readily distinguished by the purple of the head, antennae, terminal segments of the body and elater, the obscure white markings on the body and especially by the nine joints to the terminal segment of the antennae. There being in *S. hortensis six* segment to the terminal joint, according to Fitch and McGillivray—but really seven if Fitch's figure is correct. The only species we know of having been found in America with nine joints to the terminal segment of the antennae is *S. roseus*, Packard, from which our species differs in the color of the body, size and habits.

Remarks:—The young of this species are lighter colored than the adults, appearing brownish to the naked eye and often show only eight joints to the terminal segments of the antennae. The older specimens acquire the blue black color and reflections. The marbled appearance of the body cannot be seen by the naked eye or a hand glass readily and the casual observer would say the body was plain, blackish. The whitish markings can be readily seen by magnifying 75 diameters. They appear as though they were under the skin and show through it. Alcohol and glycerine specimens show the markings plainly.

By careful examination of alcoholic specimens we found there was a median dorsal brownish stripe extending from the head half the length of the body and ending in a clover leaf white spot. There are three obscure transverse bands made up of white spots, giving the surface a mottled appearance. The anterior band from dorsal view shows two white spots each side the median line. The second stripe bears five oblong spots each side of the median line and lower on the sides an S shaped marking composed of a chain of white blotches. Still lower on the side and anterior to the first and sloping forward is another S formed by a chain of spots, the lower loop of the first S making the posterior loop of the second. See Fig. 4.

Starting near the base of the manubrium and running obliquely up the side of the body and ending in the dorsal view is a stripe of oblong whitish spots. The white spot next to the dorsal end placed inward out of line. Fig. 3, a.

We have tried to show the arrangement of these markings in Figs. 3 and 4.

Description of Figures:—Fig. 1, drawn by Mr. J. H. Emerton from live specimens, shows well the form of the body and the obscure transverse bands. The drawing was made from live specimens. Fig. 2, drawn by Mr. Emerton, shows a ventral view of the same. Fig. 3, drawn by the writer, shows in detail the white markings as seen in alcoholic specimens, examined by high powers. No attempt is made to show more than the location of the markings. Fig. 4, is a side view showing location of the spots. Fig. 5, shows structure of the foot.

Remedies:—We do not agree with Fitch that the work of the Smynthurids is entirely secondary, at least this species is capable of sucking the juices in some way without the aid of other insects. The above species was very abundant on cucumbers in my garden this season but we did not notice the Flea Beetle. Some times there would be more than a dozen on a single leaf. In a few days the leaves turned whitish and on examination the epidermis was found full of little pits. Rarely, if ever, was there a hole through the leaf. They attack the new, young plants, eating the seed leaves (cotyledons). The application of dirt, ashes, sulphur or pyrethrum while the dew is on will act as deterrents until the plants are larger when they appear to do but little damage. We searched for specimens June 25th, and found them very scarce.

THE CURRANT FLY. GOOSEBERRY FRUIT FLY.*

Epochra Canadensis, Loew.

ORDER DIPTERA: FAMILY TRYPETIDAE.

BY F. L. HARVEY.

HISTORY AND DISTRIBUTION.

This species was first considered by Loew in 1873, from a single faded female contributed by Osten Sacken. Osten Sacken's material may have come from Maine, as he gives Norway, Maine, as the locality, the specimens having been collected by S. J. Smith. Loew gives Canada as a locality upon the authority of Mr. Provancher. How long the species had been known before it was described does not appear, but Osten Sacken says it "seems to be common in those regions." If its habit of infesting currants was known in 1873, no mention is made of it. It is next considered by Saunders in 1883. During the intervening ten years its currant infesting habit became known and some attempts were made to determine its life history.

In 1891, Prof. Gillette found it very abundant in Colorado, infesting gooseberries, this being the first authentic account of its infesting that fruit. Prof. Gillette also added many facts regarding the life history.

We find no reference to this insect in the Agricultural and Horticultural Reports of Maine, and if it has done injury heretofore it has not been recorded.

Mr. Z. A. Gilbert says he was formerly troubled by such an insect, but stopped growing currants for a time and then resumed and has not been troubled since. Mr. D. H. Knowlton, Farmington, says his currants have been infested for several years.

It is quite certain that *Epochra Canadensis*, Loew, is a native American species, distributed throughout the northern part of the United States, and in Canada, extending from the Atlantic to the Pacific coast.

This insect is widely distributed in Maine and is capable of doing great injury to currants and gooseberries and growers of these berries should become acquainted with it and be on the lookout for its depredations.

* Reprinted from Maine State Board of Agriculture, Entomological Report No. 13.

General Description.

Perfect insect a two-winged fly about the size of a house fly. Pale yellow or orange with greenish iridescent eyes and dark bands across the wings. Found about currant and gooseberry bushes from the last of May and through June in Maine. Stings the currants, depositing an egg under the skin, that hatches and develops into a small white maggot causing the fruit to turn red and drop prematurely. The maggots when grown leave the fallen or hanging fruit, enter the ground, change to the pupa state from which the fly emerges the following June.

Life History.

The flies emerge the last of May or early in June, depending on the season and location of the bushes. The time of emergence extends over about three weeks. The flies live about a month. They mate soon after they emerge and begin laying eggs, selecting the larger currants at the base of the bunches first and depositing eggs in the others as they attain sufficient size until the eggs are all deposited. It often happens that several currants at the ends of the bunches are not affected and later develop good fruit. Usually only one egg is laid in a currant. The flies are capable of laying at least two hundred eggs and as they live only about a month must lay several every day. The fly when about to lay an egg lights on the currant and in a nervous, restless manner keeps the wings in a constant fanning motion. She often examines several currants before finding one to her fancy. Usually one of the large currants in the upper part of a bunch that is in the shade is selected. The eggs are laid one in a place at one side of the puncture made by the ovipositor and so close to the skin of the currant that they can usually be plainly seen through it. The eggs are opalescent, white, oblong and pedicilate and about one twenty-fifth of an inch long. They soon hatch into a white footless maggot with thirteen segments to the body, the head armed with a pair of black parallel retractile hooks, the rasping organs of the maggot. The larva requires about three weeks to mature, when it is about one-fourth to one-third of an inch long.

When hatched the larva is about one-twenty-fifth of an inch long and as soon as it emerges from the egg begins to

travel, often leaving a delicate light colored trail close under the skin which can be seen through it. After traversing from a third to a half the distance around the currant it locates, entering in most cases one of the seeds, disappearing entirely within it. Sometimes the larva locates near the puncture and sometimes the exit hole is on the opposite cheek from the puncture. As it grows the head finally protrudes from the seed as shown in the Plate, Fig. 7. After feeding upon the contents of a seed and having grown too large to find lodgment within it, it locates between the seeds in the pulp and then gnaws holes in the seeds, eating the contents of one after another until often half a dozen are consumed before the larva is grown. It seems to reject the coats and the clear gelatinous envelope that surrounds the seeds. The refuse of the seeds eaten turns black and becomes cemented together. A black spot becomes visible through the skin. The location of the larva can be told readily as the currant infested soon begins to show a clouded appearance where it is located and finally turns red and a black spot appears. Infested fruits ripen earlier. Often a half grown larva will be found with the head end half buried in a seed. Finally when full fed the larva gnaws to the surface and cuts a circular hole with ragged edges through the epidermis by means of which it emerges.

The larvae often leave the fruit before it drops, but fully half or more are still in the currants when they fall and remain there a greater or less time. The currants often drop before the maggots are mature. When ready to transform, they leave the currants, enter the ground under the bushes, usually less than an inch, shorten up and assume the pupa stage in which they remain, gradually transforming into the fly, until the following spring when they appear, there being but a single brood.

Fig. 1.

Fig. 2.

Fig. 4.

Fig. 5.

Fig. 3.

Fig. 8.

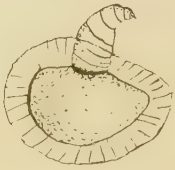


Fig. 7.

Fig. 6.

Fig. 10.

Fig. 9.

The Currant Fly, Gooseberry Fruit-Fly.
(*Epochra Canadensis, Loew.*)

EXPLANATION OF PLATE I—THE CURRANT FLY.

(*Epochra Canadensis*, Loew.)

All excepting Figure 1 were drawn by the writer.

Figure 1. The female fly enlarged about seven and a half times. Drawn by Mr. J. H. Emerton from slides of the wing and ovipositor prepared by the writer and from pinned flies. The two basal joints of the abdomen are drawn as one. The real number, including the long terminal segment is seven instead of six.

Figure 2. Egg showing form, sculpture and pedicel, enlarged fifty times.

Figure 3. The larva enlarged about five times.

Figure 4. The pupa enlarged eight times.

Figure 5. The caudal spiracle of the larva much enlarged.

Figure 6. First two segments of the head showing the tubercles on the head, the rugose mouth and the rasping organs. Enlarged twenty-five times.

Figure 7. Seed of currant with gelatinous envelope showing larva protruding from it. Enlarged.

Figure 8. External genitalia of male. Enlarged twenty times.

Figure 9. Side view of abdomen of female with ovipositor protruding and bent backward in the position it takes as the egg is deposited under the skin to one side of the puncture. Enlarged.

Figure 10. Abdomen of male with gentalia and showing six segments. Enlarged.

Remedies.

We have had no experience with this insect as it is new to Maine as an injurious species. From a study of its life history we discover only one vulnerable point. The insect spends nearly eleven months of the year in the ground. In the winged stage it cannot be destroyed so far as we know. The eggs are deposited under the skin of the fruit and spraying would do no good. Part of the infested fruits drop prematurely and the worms remain in them for some time before they emerge and go into the ground. Based upon this last

habit we would recommend gathering the fallen currants frequently and burning them. This remedy cannot be relied upon to destroy *all* the flies as quite a number of maggots leave the fruit before it falls. It can be depended upon to destroy fully half if not more and can be employed to keep them in check.

Our western correspondent, Dr. W. A. Thornton, thinks that allowing young chickens about the bushes early in the season and large fowls later after the fruit is gathered will keep them in check.

As the pupae are found only about an inch below the surface, they could be destroyed with little trouble by removing the soil to that depth from under the bushes and burying it deep or depositing it on a road or some exposed place.

Deep spading and turning to bury the pupae, or stirring the surface of the soil after cold weather so as to expose the pupae are methods worth trying.

As these flies are weak and liable to perish if any obstruction is offered to prevent their coming out of the ground, we would recommend a mulching of coarse straw or hay, several inches deep, placed under the bushes and out as far as the branches extend, and well packed.

The maggots are footless and unable to crawl much. Taking advantage of this fact we intend to try this season putting a receptacle under the bushes to catch the falling maggots and infested currants when they fall. A cheap grade of tar paper will be used. Strips will be placed each side of the row and fitted closely where they meet, and an inch cleat tacked along the outer and upper edge and at the ends. The paper will slope away from the bushes. It can be made in sections and stored for use a second season. It should be put under the bushes about June 15th and remain until the worms all leave the fruit, or about August 1st, when the fallen fruit and pupae in the receptacles should be carefully collected and burned. But few of the maggots could escape this treatment.

We have not discovered any parasites to help check the pest. Short bearing years would tend to reduce the numbers.

NOTES ON INSECTS OF THE YEAR.

F. L. Harvey.

Stone Flies or the nymphs of these interesting insects are often received for determination. The nymphs are found in streams under stones, and the flies in damp or shaded places. Some of the smaller species known as Snow Flies come out early in the spring and are found on the surface of the snow and often fly into buildings. They may be known by the square thorax and broad, plaited hind wings, which lie flat on the abdomen when folded. The antennae are long and the veins of the wings prominent. They are not injurious. The nymphs are the favorite food of brook trout. See figs. 1 and 2.

The Cocks-comb Gall of the elm was received this season and may be added to the pests attacking that favorite shade tree in Maine. These galls are the work of a species of plant louse.

The Zebra Caterpillar (*Mamestra picta*) is a common insect in Maine, doing considerable damage to various crops. They are particularly bad in gardens. They were reported the past season as damaging the silks to sweet corn and feeding on turnips. They were quite bad on peas in gardens. These are handsome caterpillars of a pale yellow color, with three broad black stripes running length wise of the body, crossed by numerous narrow, pure white lines. They curl up like cut-worms when disturbed. The moths have dark chestnut fore wings and pale yellow hind wings and expand one and three-fourths inches. See fig. 3.

The Potato-Stalk Borer (*Gortyna nitela*) was reported as doing considerable damage to potatoes in Western Maine the past season. This insect is on the increase in Maine. The larva bores into the pith of potato stalks, causing them to wilt. The wilting plants should be pulled and burned so as to kill the worms within them.

The Apple-tree Tent-Caterpillar and the Forest Tent-Caterpillar were very abundant the past season in the west-

ern and southwestern parts of the State. As it was an off bearing year the orchards of Maine were shamefully neglected. Tent-caterpillars were allowed their own way, and it was common to see nice orchards badly eaten, and from one to several tents in a tree.

The abundant crop two years ago, and consequent low prices, the small crop of last season, with small returns, combined to discourage fruit growers and cause the neglect of orchards. We believe in periods of ten years, that the orchard is the best paying part of the farm. To turn the orchard over to the ravages of insects and fungi in off bearing years is a short sighted policy.

In a shy bearing year, trees have the opportunity to regain vigor from overbearing and lay up material for full bloom the following year. Nourishment is elaborated by the leaves and therefore foliage-eating insects sap the vitality of trees. The best time to strike insects that attack the fruit a hard blow, is in shy bearing years, when the food supply is limited.

By the neglect of orchards last year, tent and forest-caterpillars will be abundant this season.

We are glad to know that orchardists are becoming impressed by the fact that the best way to cope with tent-caterpillars, especially in young orchards, is to gather the egg clusters during the winter, or when the leaves are off.

The indiscriminate destruction of all kinds of eggs found attached to the limbs of apple trees would be bad policy, as beneficial and injurious insects would suffer alike. It would be but little trouble to send specimens of egg clusters found to the Station and learn which kinds should be protected. Several parties have availed themselves of this privilege the past season, and in all cases among the lots of eggs sent were several cocoons of beneficial Ichneumons.

Beech-bud Insect. We received from Mrs. Florence W. Jaques, Farmington, Maine, a lot of beech buds that were killed by an insect. They were the terminal buds, and had turned brown. An examination showed that the young leaves had been eaten and that the insect had made his exit by boring a small round hole through the scales near the base of the bud. This insect must do its work early in the spring, as the speci-

FIG. 1

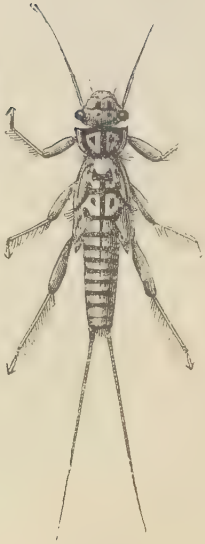


FIG. 2

FIG. 3.

FIG. 4.

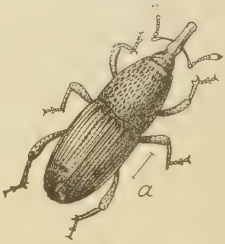


FIG. 5.

Figs. 1 and 2 are from Smith's Economic Entomology.
Figs. 3, 4 and 5 are from publications of the U. S. Department of Agriculture.

mens were received the last of May, and the buds were dead and the insects gone. The trees were in grounds in Farmington, and the effect on them was quite noticeable. We have never seen the work of such an insect in the forests of Maine. This was probably the work of a small moth. We call attention to it as we do not know the insect and will be pleased to receive specimens of the buds with the worms in them. They should be looked for early in May. Mrs. Jaques informs us that she saw small worms emerging from the holes earlier in the season than the date of sending the buds.

The Brown-tail Moth, an insect from Europe that has secured a foothold in Massachusetts and is claiming the attention of the Gipsey Moth Commission as a bad insect, is said to have been found in Maine, as indicated by the following letter from Mr. Sessions, the secretary.

"We are now making an inspection of the territory infested with our new imported pest, the brown-tail moth (*Euproctis chryssorrhoea*). Our inspector in discharge of his duty called on Dr. Geo. E. Osgood of 283 Highland Avenue, Somerville. The doctor is one of the reliable physicians of Somerville. His place is infested with the moth. He said that he saw the brown-tail moth in South Berwick, Maine, while on his last summer's vacation, and was sure that it was identical with the Somerville pest. He also said that while he was in South Berwick he professionally treated two cases of poisoning by contract with the moth and that the symptoms of the patients were identical with those of his Somerville patients who had been poisoned by the brown-tail moth. The premises in South Berwick are owned by the doctor's father-in-law, Andrew Whitehouse, 10 Goodwin St., South Berwick. I send you notice, that you may take such measures as you think proper in the case. I cannot of course vouch for the doctor's judgment in the matter. The caterpillars he saw in South Berwick may be something else, but I give it to you as I had it from our inspector."

We wrote Mr. Whitehouse for specimens, but he was not able to send any. We will investigate the matter next season.

The Fickle Midge (*Sciara inconstans*, Fitch) was reported by Mrs. R. S. Warren, of South Deer Isle, as eating roots and penetrating the bulbs of *Gloxinia* plants. So far as we know this is a new habit for this species. Specimens of the bulbs

received were channeled by the larvae. This insect will be considered in our next report.

Various species of ANTHOMYIIDS are common in Maine, attacking beets, working between and under the epidermis of the leaves, making light colored trails. Radishes, bean-seedlings and onions are often badly attacked. The Onion Maggot (*P. ceparum*) was reported as bad in Maine. We planted a bed of onion seed in our garden in Orono, and nearly every onion was attacked by this species.

Care should be taken to burn infested plants while the maggots are still in them.

THE RAIL-ROAD WORM (*Trypeta pomonella*) will probably not be so abundant, as the short apple crop gave them much less chance to multiply than usual. This insect could have been about destroyed if pains had been taken to gather the much fewer wind-falls.

THE CURRANT FLY (*Epochra Canadensis*) was more abundant than usual about Orono.

THE RICE WEEVIL (*Calandra oryzae*, L.) was reported as quite abundant in the store houses for grain of the Swan and Sibley Company, Belfast, Maine. We recommended the carbon bisulphide treatment. See fig. 4, *b* and *d*; fig. 5, *a* and *c*.

THE SPOTTED PARIA continues its novel habit of attacking the young buds of blackberries and raspberries. The past season this pest nearly ruined an acre of the above plants on the farm of Greenvill M. Foss and Son of Standish, Maine, as reported by Mr. C. S. Phinney. Experience with this insect indicates that it will not continue its depredations from year to year. See fig. 6, Expt. Sta. Rept. 1895.

FOREST INSECTS. We received a letter from Mr. Austin Cary, who has spent considerable time the past season exploring the forests of Maine, calling our attention to the depredations of a timber beetle (*Dendroctonus rufipennis*) that is doing damage to spruce timber in Maine. The study of timber insects is not only a great undertaking, but one of much importance. As it is impossible for the Station Entomologist to find time to enter upon the work, we hope that timber owners and the Forestry Commission may become interested in the matter and that the legislature will provide the funds to make the necessary investigations.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Centipede Species.		Several parties	Found in fruit shipped from the South.
2	Stone Fly	*Perla bicaudata*	Mrs. Sarah F. Lee, Oakland.	Larvæ under stones in streams.
3	Helgramite-Fly	*Corydalis cornuta*	A. L. Douglass, East Dixfield	The perfect insect. The larva is used for fish bait.
4	Cock's-Comb Gall	*Colapha ulmicola*	J. F. Bailey, Bradford	Galls on elm leaves.
5	Yellow-Necked Apple-Tree Caterpillar	*Datana ministra*	Wm. S. Robertson, Weld W. W. Perkins, Andover	Feeding on foliage of apple trees.
6	Currant Span Worm	*Diastictis ribearia*	Mrs. Wealthy Page, Hartland	
7	Zebra Caterpillar	*Mamestra picta*	Minot Packing Co., Mec. Falls. C. O. Brown, Etna	Eating corn silks and turnips.
8	Potato-Stalk Borer	*Gortyna nitela*	W. A. Noyes, Auburn E. C. Brown, Riverside	Boring in the pith of potato stalks.
9	White-Marked Tussock Moth	*Notolophus leucostigma*	D. P. Boynton, Monmouth	Clusters of eggs on apple tree twigs.
10	Luna Moth	*Tropæa luna*	C. F. Kemp, White Rock	Sent for determination.
11	Io Emperor Moth	*Automeris io*	B. McAllister, Lowell	Had eaten all the leaves from the top of a pear tree.
12	Cecropia Emperor Moth	*Samia cecropia*	A. W. Farrer, Ripley	Cocoon on apple twig. See Experiment Station Report, 1894, page 111.
13	Velleda Lappet-Moth	*Tolype Velleda*	W. E. Blanchard, Cumb. Center	On apple tree.
14	Apple-Tree Tent-Caterpillar	*Clisiocampa Americana*	C. N. Wells, Auburn C. H. Page, Winthrop	Clusters of eggs on apple tree twigs.
15	Forest Tent-Caterpillar	*Clisiocampa disstria*	C. N. Wells, Auburn W. W. Perkins, Andover	Egg clusters on apple trees.
16	Mourning Cloak Butterfly	*Euvanessa antiopa*	G. F. Rowell, Monmouth	Foliage of willows.

INSECTS EXAMINED IN 1897—CONCLUDED.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
17	Gloxinia Fly, Fickle Midge	*Sciara inconstans*, Fitch	Mrs. R. S. Warren, S. Deer Isle	Larvæ attacking the roots and bulbs of Gloxinia plants.
18	Anthomyiid		Mrs. A. M. Huston, Winn	Larva attacking bean seedlings.
19	The Onion Maggot	*Phorbia ceparum*	G. T. Allen, Haven	Larva attacking onions.
20	Bean Weevil	*Bruchus obtectus*, Say	L. H. Richards	Attacking stored beans.
21	Rice Weevil	*Calandra oryzæ*, L	Swan & Sibley Co., Belfast (per Mr. Bickford)	In grain bins in store.
22	Meal Beetle	*Tenebrio molitor*	Swan & Sibley Company	In grain bins.
23	Round-Headed Apple-Tree Borer.	*Saperda candida*	W. E. Ingersol, Epping	Attacking trunk of apple trees.
24	Spotted Paria	*Typophrus canellus gilvipes*, Dej	C. S. Phinney, Standish.	Attacking raspberries and blackberries. See Expt. Sta. Report, 1895, page 106.
25		*Obesia bimaculata*	F. L. Harvey, Orono	Attacking blackberry leaves.
26	Shot Borer	*Xyleborus pyri*, Peck	W. B. Selwood, Perry	Attacking the trunks of young apple trees.
27	Buffalo Beetle	*Anthrenus Scrophulariæ*	P. H. Vose, Bangor—Auburn	Attacking carpets and woolen goods.
28	Maple-Tree Borer	*Plaginotus speciosus*	F. J. Libbey, Richmond	Attacking maple trees.
29	Horntail Pigeon Tremex	*Tremex Columba*	W. Stanwood, Bethel	Attacking and destroying maple trees.
30	Pear Tree Slug	*Eriocampa cerasi*	F. O. Tarbox, W. Kennebunk	Attacking foliage of pear trees.

See pages 118 and 125.

AVERAGE PER CENT OF SOLIDS AND FAT, AND AVERAGE DAILY YIELD OF MILK, SOLIDS AND FAT.

Period III.	Cows.	Solids.	Fats.	Daily yield of milk.	Daily yield of solids.	Daily yield of fat.
		%	%	Lbs.	Lbs.	Lbs.
First week	Adle	15.99	6.27	–	–	–
	Buttercup	15.48	5.92	–	–	–
	Dudley	14.44	5.05	–	–	–
	Pansy	14.77	5.32	–	–	–
Second week	Adle	16.94	6.45	–	–	–
	Buttercup	16.13	5.85	–	–	–
	Dudley	14.90	4.95	–	–	–
	Pansy	16.71	5.85	–	–	–
Third week	Adle	16.86	6.15	–	–	–
	Buttercup	15.86	6.35	–	–	–
	Dudley	14.78	5.65	–	–	–
	Pansy	16.03	5.70	–	–	–
Fourth week	Adle	16.69	6.55	–	–	–
	Buttercup	15.36	5.80	–	–	–
	Dudley	15.54	5.40	–	–	–
	Pansy	15.30	5.20	–	–	–

AVERAGE DAILY YIELD OF FAT FOR EACH WEEK PER COW.

	Period I.		Period II.		Period III.	
	Digestible fat fed daily per cow 0.36 pounds.		Digestible fat fed daily per cow 0.86 pounds.		Digestible fat fed daily per cow 0.55 pounds.	
	Fat. Per cent.	Fat. Pounds.	Fat. Per cent.	Fat. Pounds.	Fat. Per cent.	Fat. Pounds.
First week	5.34	0.90	6.39	–	5.64	–
Second week	5.21	0.86	6.43	1.00	5.78	–
Third week	5.66	–	6.05	.97	5.96	–
Fourth week	5.94	0.91	6.15	1.02	5.74	–

INJURIOUS MILLIPEDES.*

By F. L. Harvey.

For several seasons, radishes grown in the forcing houses of the Station have been more or less covered with excrescences, rendering them unsightly and unfit for market. From one to six excrescences are often found on a single radish, and five per cent of the crop is sometimes affected. After a careful examination of the beds, the injury has been traced to the biting of the radishes by two species of millipedes, viz.,—*Polydesmus monilaris*, C. L. Koch, and *Iulus hortensis*, Wood. *Both of these species have been caught many times with their mouths on the excrescences in the various stages of their development. Millipedes have been reported as doing injury to the roots of corn and strawberries and *Polydesmus complanatus*, according to Fitch, causes club foot of cabbage. We find no records of any species having been injurious to radishes. While hunting down the above culprits, other species of millipedes were found in the forcing houses and are included below. Though not detected biting the roots of plants, their presence is objectionable as they feed upon organic matter that might be appropriated by plants. So far as we know, no species of *Myriopoda* have been reported from Maine, and this article may be regarded as a small contribution to the subject.

We are under obligations to Prof. O. F. Cook of the Department of Agriculture, Washington, D. C., for the examination of specimens, and to Mr. L. H. Horner of the Junior Class of the University of Maine for Figs. 2 and 4. Figs 1 and 5 are after Wood and Fig. 3 a camera sketch by the writer.

---

*Millipedes are supposed to usually feed upon decaying organic matter. We doubted for a long time that their work upon radishes was primary but from a careful study of the problem are forced to believe it.

* Papers from the Maine Agricultural Experiment Station. Entomology No. 15

FIG. 5.

FIG. 4.

FIG. 2.

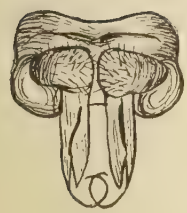


FIG. 1.

FIG. 6.

FIG. 3.

FIG. 7.

Polydesmus monilaris C. L. Koch—*P. serratus,* Wood.

Description: Deep brown. Antennæ pubescent, club-shaped; the dorsal plates of the segments armed with two rows of scales and a broad anterior obsolete series, their lateral margins toothed. Length one-third to one-half inch. The male genitalia hairy with a double terminal spine. See Fig. 1. Head and terminal segment, Fig. 5.

Remarks: This was originally described from Pennsylvania specimens and is a native species. In Maine it is the most common form found in cellars and under boards and rubbish everywhere out of doors. It is abundant in the greenhouses of Orono in the radish beds, and is one of the culprits, having been caught several times with its mouth in contact with the tubercles found on radishes.

Iulus hortensis, Wood.

Description: Brown, ornamented with a row of black spots on the side; antennæ rather short; hairy, slender, club-shaped; segments of the body 42; scuta closely channeled, both above and below; spine at the end of the body wanting; plate in front of the anus triangular, with its apex rounded. Length, 1 inch. The head and terminal segments are shown enlarged five times in Fig. 2.

Remarks: The young and the adults which have just molted are lighter colored and show the spots on the sides plainly. The spots do not show well on fully colored specimens.

This species is abundant throughout the greenhouses at Orono, and particularly so in the radish beds. It has also been caught biting the radishes, causing excrescences.

Iulus virgatus, Wood.

Description: Deep brown; back yellowish; median dorsal line black; antennæ moderately large, pilose, club-shaped; segments 30-35. Dorsal plates distinctly grooved. Spine at the end of the body wanting, anal scale sparsely hairy; preanal scale, broad, subtriangular with a rounded apex. Length from ½ to ¾ inch.

Remarks: The sides of the body of well colored specimens are deep brown or almost black. The dorsum approaches a fawn yellow and the median dark line is pronounced. Our specimens do not show the lateral bands mentioned by Wood and Bollman

but are otherwise characteristic. We have found but very few specimens of this species about the greenhouse and no damage has been traced to it. It occurs in a cellar in Orono under boxes and barrels. It was probably brought into the cellar in dirt used for storing celery and roots, and into the greenhouses with plants brought in for the winter. It has been reported from Pennsylvania, District of Columbia and Indiana. It is without doubt indigenous to Maine.

Paraiulus immaculatus Wood.

Description: Deep reddish brown without spots; antennæ rather long, slender and hairy; anterior margin of the head notched; segments 48-51; dorsal plate channeled below; the spine at the end of the body, large, hooked, robust, acute. Length, 1 to 1½ inches.

Remarks: Was originally described from specimens collected in the Catskill Mountains, N. Y. It is found in the woods of Maine, and also is quite common in the greenhouses at Orono. As leaf mold and sphagnum from this locality are used in the beds, this species was introduced that way. So far as we know it has done no injury.

Orthomorpha gracilis C. L. Koch.

Description: Dark mahogany brown with the lateral laminæ prominent and yellow, giving the appearance of a yellow stripe along each side. Length, about an inch. The male genitalia are shown much enlarged in Fig. 3, and the head and terminal segments enlarged two and one-half times in Fig. 4.

Remarks: Widely introduced in greenhouses in Europe and America. Found throughout the tropics and according to Prof. O. F. Cook probably a native of the Malay region. At Orono it is found in abundance under pots in the sphagnum moss on the shelves, and also about the roots of plants, near and in the holes in the bottoms of the pots. Some times a half dozen specimens were taken from under a single pot. This species has never been found in the radish beds, but in a section of the house devoted to tropical and other plants in pots. It was probably introduced with some of the tropical plants. Whether it does injury to these plants we are not certain. We are of the opinion that it feeds on the decomposing sphagnum and other organic matter present.

REMEDIES.

No remedies other than hand picking have been tried in the houses at Orono. It has been found that the millipedes work at night mostly, and early in the morning are found near the surface of the ground. During the day, they burrow and are more difficult to find. The morning, therefore, is the best time to hunt for them, They do more injury in sub-watered than in surface watered beds. We would suggest putting slices of potatoes poisoned with strychnine in the beds. Of course, if this or any other poison is used, the radishes should be carefully washed before marketing. Chips of wood scattered in the beds afford hiding places and these could be examined in the morning for specimens. A more troublesome way is to heat the dirt used in the beds. This could be done by connecting a heating box containing a coil of perforated pipes with the engine, or by forcing steam into the dirt in the beds by means of a hose and nozzle.

AN INJURIOUS CADDICE FLY.

F. L. Harvey.

Family Limnephilidæ; Genus Limnephilus; Sp.

In the latter part of June, 1898, we received some caddice fly larvæ, their cases and their work from Mr. William Miller, manager of the Mt. Desert Nurseries, Bar Harbor, Maine. Mr. Miller stated regarding them: "That they have practically eaten up our hardy water lilies. I send you portions of the stem and leaf, illustrations of their work. As soon as we discovered what was destroying them, we took steps to eradicate them, and also removed all of the decayed and badly damaged foliage which remained. Our hardy aquatic pond will contain, perhaps, 300-350 square feet. The first three days one man gathered each day, about 3 gallons of the case worms. In another week or ten days, there would not have been a particle of leaf or stem in the pond. Some of the kinds are completely killed out and two-thirds of the pond is bare that was practically full last year. Since we have been keeping them down by hand picking, those that were strong enough and not destroyed before the trouble was discovered, have made a rapid and wonderful growth. Of course, in a large or deep pond, hand picking would be out of the question. Having control of the water level, we lowered it so as to reach them. The larvæ crawled up the stems of the lilies literally covering them. The stems were badly eaten, often nearly gone, also the under sides and margins of the leaves were attacked. I should like to know what they are? Is there anything that can be done to destroy them besides hand picking? Any information you can give in regard to destroying them would be gladly received, and I should like to know if they have been before reported as giving much trouble."

The injury being new to us, we wrote Dr. L. O. Howard of the Division of Entomology, United States Department of Agri-

culture, Washington, D. C., who informed us that the injury was also new to him. As caddice flies cannot be classified beyond the genus by the cases and larvæ, we wrote to Mr. Miller to catch some of the flies for us. Such thorough hand picking had been done that probably no larvæ were left to emerge, and though the pond was watched during the season, no flies were taken. The larvæ sent us by Mr. Miller were dead when received so we were not able to rear the flies.

During August we were in Bar Harbor and visited the Mt. Desert Nurseries and examined the pond. No caddice flies were then on the wing. We arranged with Mr. Miller to transfer some of the case-worms to a tub in the house and try to rear the flies. Later he informed us that no live case-worms could be found. Should they give trouble again, we will investigate farther.

We sent some of the cases to Mr. Nathan Banks who thinks they belong as placed below. To Mr. Miller, we made the following reply:

"The case-worms you sent belong to the Order *Trichoptera* (Caddice Flies), Family *Limnephilidæ*, Genus *Limnephilus*. It will be necessary to have the flies to decide the species. I send you a drawing of a species of caddice fly and wish you would send me any related insects you find about the pond.

"Caddice flies lay their eggs upon the surface of water plants. The young make cases in which they live, or some species appropriate the hollow stems of water plants. Some of them are carnivorous and feed upon other insects, but most of them are vegetable feeders. But little is known about their food habits excepting that many feed on water plants. The injury was entirely new to me. There is no record of caddice flies having been injurious to water lilies. They might commonly feed upon our wild species and the habit be overlooked as the plants are not of economic importance. They might have been in your artificial pond in some number and have been overlooked. It was the unusual number that attracted attention. As you have control of the water level in the pond, there is no better remedy than hand picking, or cleaning the pond in the winter. As you have done a thorough job of hand picking, probably you will

never be troubled with them in such numbers again. We will be pleased to investigate farther should they continue to trouble you."

DESCRIPTION OF CASES AND LARVÆ.

Cases about three-fourths of an inch long and one-fourth wide. Of the log-house pattern. They seem to be built of fragments of water-lily stems. One of them ornamented with the case of a smaller species. Fig. 7 shows six of these cases, natural size.

Larvæ about three-fourths of an inch long. The portion within the case pale brown; the protruding thoracic segments and head much darker. The portion within the case provided with blunt hairs. The first abdominal segment enlarged and produced into tubercles above at the sides and below, to attach the larvæ to the case. Fig. 6 shows the larva enlarged two times.

INSECTS OF THE YEAR.

F. L. Harvey.

Short-nosed Ox-louse. (*Hæmatopinus eurysternus.*)

This species is found about Orono and is probably common in Maine, though it has never been sent to the Station before this season. The *Long-nosed Ox-louse* was reported in 1895. For description of these parasites see Experiment Station Report, 1895, page 99.

Walking Stick. (*Diapheromera femorata.*)

Specimens of this curious wingless insect were received from J. H. Hammond, Sanford. This species is certainly rare in Maine. These are the first we have seen from the State.

Apple-tree Aphis. (*Aphis mali* Fabr.)

Was reported as doing much damage to the foliage of apple trees and plum trees in several localities. Spraying with kerosene is probably the best remedy. The application should be made as soon as the insects appear. This insect is considered in Experiment Station Report 1888, p. 170.

Caddice Fly.

The larva of a caddice fly was reported as doing damage to water lilies in an artificial pond at Bar Harbor. Considered in detail elsewhere.

Bud Moths.

Several species of bud moths were reported the past season as doing much damage to the terminal buds and flower buds of apple trees. Spraying with Paris green as soon as the leaves begin to unfold, ought to destroy them.

Entomology No. 16.

The Red Humped Apple Worm. (*Œdemasia concinna.*)

Was reported from several new localities the past season. It seems to be on the increase in Maine. See Experiment Station Report, 1890, p. 135.

Fall Canker Worm.

This insect continues to do some damage in Southern Maine. It will be remembered that it went across the State in a wave from the northeast to the southwest. It was also reported the past season from Aroostook county.

The Zebra Caterpillar. (*Mamestra picta.*)

This is one of the most common caterpillars in gardens and cultivated fields. It is a general feeder found on a great variety of plants. See Experiment Station Report, 1897, pages 173 and 175.

Apple-tree Tent Caterpillar. (*Clisiocampa americana.*)

Was, as we predicted, very abundant particularly in southern and western Maine. The farmers who took care of their trees last year are now reaping the benefit, as the apple crop was short and apples are high.

The Brown Tailed Moth.

Mr. Andrew Whitehouse, South Berwick, Me., upon whose premises the above pest was found in 1897, writes February 2d as follows: "I cannot find any specimens to send you. In the summer of 1897, my boy was badly poisoned by them. They were numerous on a woodbine on my premises and a few on my fruit trees. Last year I cut down the woodbine and burned it, and have not seen any since." Mr. Whitehouse thinks they came from Somerville, Mass., on roses.

The usual number of luna, cecropia and polyphemus moths were received. We received a polyphemus cocoon that was spun in a stocking. The caterpillar climbed up a post and out on the line to where the stocking hung, then down and into the stocking. When found the stocking had been on the line only a few hours.

DRONE OR CHRYSANTHEMUM FLY.

The larvæ of these flies have long breathing tubes at the end of the body which give them the name of rat tail larvæ. Specimens reported were breeding in a tub containing a decoction of tobacco stems. We found the larvæ abundant at McLeod's lumber camp in a tub by the blacksmith's forge containing stagnant water.

APPLE MAGGOT. (*Trypeta pomonella.*)

Was not as prevalent as usual, though doing considerable damage in some parts of the State.

CURRANT FLY. (*Epochra canadensis.*)

Was reported from Gardiner on currants. It was common also about Orono. We would like to hear from anybody whose currants are stung by a fly and turn red early, and drop.

FICKLE MIDGE. (*Sciara inconstans.*)

This was reported last season as attacking gloxinia bulbs. The same complaints have been made the past season. Mrs. R. S. Warren, South Deer Isle, sent us specimens which she called springtails that were eating the leaves and blossoms. She writes, "I am positive now that the springtails destroy my gloxinias, for I have found them on the blossoms and stems where they had eaten the stem half through and the blossoms withered. Also they burrow into the leaves and sap them until they dry up and die." The specimens sent were Thysanurans and an unknown species of Thrips. The latter were no doubt the cause of the injuries. Mrs. Warren put slices of potato around the plants and the insects collected on them in great numbers. Probably the use of the potato as traps would be a good way to destroy them.

BUFFALO CARPET BEETLE. (*Anthrenus Scrophulariæ.*)

Reported from Winthrop and Orono. Beetles in the house. These beetles are attracted by flowers that are in bloom at the time when they are on the wing, and they can be used as traps. The following from the Thirteenth Report of the Entomologist of the State of New York, page 359.

"Mr. M. B. Coombs of Utica, N. Y., writes, 'My sister has for several years kept a bed of small tulips for drawing the beetles. They congregate almost entirely on the creamy or yellow shades. For about two weeks with a pair of tweezers she picked out from them from two to three dozen on unfavorable days, and hundreds on quiet sunny days.' "

May Beetle. (*Lachnosterna fusca.*)

Mr. Kirk of Bar Harbor sent grubs of the above species and wrote as follows: "They have worked under the surface of the turf about two inches and eat everything before them. They have killed outright about 15,000 square feet of my tennis court. Most of the damage was done in July and August. I have had the infested ground dug up and the insects picked out. I have picked up more than a bushel." We wrote Mr. Kirk, calling his attention to the remedies usually applied for white grubs.

Cucumber Beetle. (*Diabrotica vittata.*)

This beetle that usually confines itself to cucurbitaceous plants was reported the past season as feeding on the buds of cultivated asters.

Potato Stalk Borer. (*Gortynia nitela.*)

Continues to do some damage to potato plants.

Blackberry Cane Borer. (*Oberea bimaculata.*)

Reported from western Maine. Also abundant at Orono on blackberries and raspberries.

Strawberry Weevil. (*Anthronomus signatus.*)

Does some damage to strawberries. More common on wild than on cultivated plants.

Pear Tree Slug. (*Eriocampa cerasi.*)

Reported as injuring the foliage of cherry trees.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Short-nosed Ox Louse	*Hæmatopinus eurysternus*	Chas. N. Wells, Auburn	On cattle. See Ex. Sta. Rept. 1895, p. 99.
2	Walking Stick	*Diapheromera femorata*	J. H. Hammond, Sanford.	
3	Apple-tree Aphis		T. D. Salley, Madison J. S. Blackwell, Madison O. B. Griffin, Reynolds F. E. Gilman, Foxcroft Austin Stover, Bluehill	On apple and plum trees.
4	Oyster-shell Bark-louse	*Mytilapsis pomorum*	Z. A. Gilbert, from Camden	On apple trees.
5	Caddice Fly	*Species unknown*	Wm. Miller, Bar Harbor	Destroying water lilies in an artificial lily pond.
6	Bud Moths	*Several species*	L. L. Phillips, Hebron	On apple trees.
7	Red-humped Apple Worm	*Œdemasia concinna*	Austin Stover, Bluehill O. B. Griffin, Reynolds Mrs. A. M. Hustin, Winn	On apple trees.
8	Fall Canker Worm	*Hisophila pometaria*	V. T. Lundvall, New Sweden. Mowe F. Article, Camden	On apple trees.
9	Zebra Caterpillar	*Mamestra picta*	Austin Stover, Bluehill A. J. Abbott, North Paris O. F. Guptil, West Scarboro I. N. Lapham, Pittston	On strawberries, pea vines, carrots and raspberries.
10	White-marked Tussock-Moth.	*Notolophus leucostigma*	C. Henry Page, Winthrop Chas. N. Wells, Auburn	On apple trees.
11	Salt-Marsh Caterpillar.	*Estigmene acræa*	B. Walker McKeen.	
12	Fall Web-worm	*Hyphantria cunea*	B. Walker McKeen, Hancock Co.	On apple trees.
13	Gooseberry Span Worm	*Diastictis ribearia*	F. L. Harvey, Orono	On gooseberries.
14	Luna Moth	*Tropæa luna*	Samuel L. Boardman, Bangor	A night flying species.

INSECTS EXAMINED IN 1898—CONCLUDED.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
15	Cecropia Emperor Moth	*Samia cecropia*	A. O. Butler, East Lebanon	Apple trees.
16	Polyphemus Moth	*Telea polyphemus*	V. T. Lundvall, New Sweden.	
17	Apple-tree Tent-Caterpillar	*Clisiocampa Americana*	Various parties southwestern Me.	On apple trees.
18	Tiger Swallow-tail Butterfly	*Jasoniades glaucus turnus*	Chas. A. Moulton, Buxton.	
19	Clouded Sulphur Butterfly	*Eurymus philodice*	R. T. Young, North Hancock	Feeding on clover.
20	Drone or Chrysanthemum Fly		M. Henry McLaughlin, Bangor	Larvæ in decoction of tobacco stems.
21	Currant Fly	*Epochra canadensis*	H. K. Morrell, Gardiner	Infesting currants.
22	Fickle Midge	*Sciara inconstans Fitch*	Mrs. R. S. Warren, So. Deer Isle	On gloxinia plants.
23	Sheeptick	*Melophagus ovinus*	Job Abbott, Dexter	Parasite on lambs.
24	Carpet Beetle, Buffalo Beetle	*Anthrenus scrophulariæ*	C. Henry Page, Winthrop.	Attacking carpet. Beetles on window in house.
25	May beetle. June-Bug.	*Lachnosterna fusca*	E. Kirk, Bar Harbor.	Destroyed 1,500 square feet of tennis court in July and August.
26	Cucumber Beetle	*Diabrotica vittata*	Mrs. Lucy Hutchins, Fryeburg / Mrs. Alice Buzzell, Fryeburg	Attacking aster heads.
27	Ribbed Pine Borer	*Rhagium lineatum*	Chas. A. Moulton, Buxton.	
28	Potato-Stalk Borer	*Gortyna nitela*	A. O. Butler, East Lebanon... / O. B. Griffin, Reynolds	Boring in potato stalks.
29	Blackberry Cane Borer	*Obesea bimaculata*	A. W. Grover, Bethel	Attacking blackberry and raspberry canes.
30	Goldsmith Beetle	*Catalpa lanigera*	W. R. Atherton, Hallowell.	
31	Strawberry Weevil	*Anthonomus signatus*	F. A. Fisher, Bluehill	On strawberries.
32	Pear-tree Slug	*Eriocampa cerasi*	Austin Stover, Bluehill	Feeding on cherry.

APPLE INSECTS OF MAINE.*

F. L. Harvey and W. M. Munson.

Specific directions for spraying the apple for insect and fungous pests have been prepared by one of the writers and will be sent, free of cost, on application to the Agricultural Experiment Station, Orono, Maine. The indiscriminate killing of insects should, however, be guarded against, as all are not injurious. Many are parasites upon the injurious species, or at some period devour their eggs or young.

These beneficial insects should be recognized when seen, and should be protected and encouraged. Attention is particularly called to the ichneumon, syrphus and tachina flies, and to the lady birds and ground beetles, illustrated in plate I. The ichneumon flies have four wings and are related to the wasps and bees. There are numerous minute forms which prey upon the eggs and larvæ of injurious insects, and larger forms that deposit their eggs upon the caterpillars. Syrphus and tachina flies are two-winged insects, the former of which, in the larval stage, devour plant lice, and the latter are parasitic upon the larvæ of other species. The lady birds and ground beetles are carnivorous, feeding upon both larvæ and perfect forms of other insects.

In the following pages only the more important insects injurious to the apple are discussed, and methods of treatment suggested.

EXPLANATION OF TERMS.

An insect with a complete life history passes through four stages; viz., egg, larva, chrysalis or pupa, and imago or mature insect. The egg hatches into the larva—i. e. caterpillar, worm, grub, or maggot, as the case may be; the larva, after a time, changes to the pupa or chrysalis, which is the inactive or resting state, and may be naked or enclosed in a cocoon; the pupa, after a longer or shorter period, develops into the imago or perfect insect.

* Taken from the Maine Agricultural Experiment Station Entomological Report No. 7

A. Insects Affecting The Trunk and Branches.

THE ROUND-HEADED APPLE TREE BORER. *Saperda candida,* Fabr.

The round-headed borer was first recorded in 1824 by Thomas Say, but was doubtless a native of America, widely distributed at that time, though unnoticed. While it prefers the apple, it also affects the native crab apple, sugar pear, thorn bush, pear, quince, and roundwood.

Description.

Eggs.—Minute, yellowish white.

Larva.—When full grown about one inch long; footless, yellowish white. Head small, chestnut brown, polished, hornlike; jaws two, black; the second joint large and broad, the next two narrow. Rings of the body (segments), from the fourth to the tenth inclusive, armed on the upper side with two fleshy warts.

Pupa.—Lighter colored than the larva and with transverse rows of minute spines on the back.

Perfect Insect.—A beetle, about three-fourths of an inch long, with two broad white stripes extending from the head to the ends of the wing cases; cinnamon brown above; hoary white below; legs, antennæ and face whitish.

Life History.

The eggs, according to Mr. Chas. Pope, who has gathered hundreds of them, are laid in a short slit, made by the beetle with the ovipositor, in the smooth bark. Sometimes the eggs are laid in the bottom of the slit next to the wood, but generally in an opening made in one side of the slit, half way through the bark. Several eggs, sometimes ten or a dozen, are laid on the same tree, being distributed around the trunk usually within six inches of the ground, but occasionally higher and sometimes at the base of the limbs. They are deposited from June to September, in Maine. The egg soon hatches and the young larva gnaws its way into the inner bark and sap wood. When winter comes the young borer works its way, in the wood, below the surface of the soil. In the spring it ascends and passes the second summer in the sap wood. It spends the second winter below the surface of the soil, as it did the first. The third summer it ascends and bores deep channels in the wood in every direction and finally bores upward and outward, nearly to the bark, lines the cavity with borings and transforms to the pupa. The third

spring it emerges, deposits its eggs, and the cycle of life is complete.

Vulnerable Points and Remedies.

The eggs are laid in the bark, in plain view, and can be readily detected and taken out. The young larvæ are readily located by the flow of sap from the wound they make, and by the chippings they push out of the mouth of the borings.

The perfect insect may be prevented from depositing eggs by the application of repellants to the trunk of the tree, e. g., tarred paper, or a mound of earth. Soft soap, or whitewash, applied to the trunk of the tree in June and July, is said to prevent the beetle from laying her eggs on the trees thus protected. The trees should be examined twice each year, in May and September, and the young larvæ removed. Should any escape, and penetrate deeply into the wood, they may be destroyed by probing with a sharp wire.

THE FLAT-HEADED APPLE TREE BORER. *Chrysobothris femorata,* Fabr.

This insect, a native of America, is common in Maine. Besides the apple, it is known to attack the pear, plum and peach, also the oak, box-elder, hickories and maples. The injury attributed to the round-headed borer is often due to it.

Description.

Eggs.—Pale yellow, varied, with one end flattened, irregularly ribbed.

Larva.—Soft, flesh-like, pale yellow; head small, deeply set; jaws black; third segment twice as broad as any of the posterior ones, and bearing on its upper surface a large, oval, callous-like projection, covered with numerous raised brown points.

Pupa.—Lighter colored than the larva and with transverse rows of minute spines on the back and a few at the extremity of the body.

Perfect Insect.—A beetle, variable in size but usually about one-half inch long, oblong-flattish in shape, of a dark, dull greenish color with a coppery reflection; under side and legs brilliant copper color; feet green. On each wing case are two irregularly oblong spots of deeper copper color than the remainder of the wing, dividing the wing cases into three nearly equal portions. The upper surface appears as though sprinkled with an ash-colored powder.

Life History.

The beetle makes its appearance in June or July in our latitude. It loves the light and may frequently be seen about the

orchard on the trees. It is very active and hard to catch, quickly taking wing. It lays, probably, about one hundred eggs.

The female fastens her eggs, singly or in groups, to loose flakes of bark, or in the crevices, by means of a glutinous substance. The eggs soon hatch and the young larvæ gnaw through the bark and live on the sap wood, making flat channels next to the bark, sometimes girdling the trees. As they get older they bore upward into the solid wood and, when ready to change to the chrysalis, gnaw to the bark and nearly through it. They then change to the chrysalis, and in about three weeks the beetles come forth. The larvæ attack the trunk and larger branches and remain in the tree but one year.

Vulnerable Points and Remedies.

Same as for the round-headed borer.

THE OYSTER-SHELL BARK LOUSE. *Mytilaspis pomorum,* Bouché.

The oyster-shell bark louse is a native of Europe and was introduced into this country, on nursery stock, about a hundred years ago. It is widely distributed, and is exceedingly common in Maine. The twigs of apple trees are often literally covered with the scales, causing great injury. Besides doing great damage to apple trees, this scale is found on the pear, plum, cultivated and wild currant, roundwood, dog wood, and several other shrubs and trees.

Description.

Eggs.—White, changing to yellowish or reddish with age, oblong, about .01 inch long; from 20 to 100 under each scale.

Young females.—Wingless, white and about .01 inch in length, move about quickly, appearing on the branches as small white specks which finally attach themselves, by their beaks, to the new shoots, where the scale is perfected.

Scale of female.—Wingless, about .08 of an inch long, narrow, widened at the posterior end, curved and shaped somewhat like an oyster shell. Brown or grayish, closely resembling the bark in color. Most frequently placed with the small end toward the tip of the twig.

Scale of male.—Much smaller than the female, wedge shaped and straight; usually placed on the leaves and rarely seen. The male insect undergoes a complete metamorphosis, and in the perfect form is provided with two wings.

Life History.

The eggs hatch late in May or early in June. If the weather is cold, the lice remain under the scale until warm weather, when they may be seen running about the twigs for a location to attach themselves. The most of these fix themselves around the bases of the side shoots of the twigs, by means of their tiny slender beaks, and live upon the sap of the tree. They gradually undergo changes. Before the close of the season the louse secretes the scale under which it lives and perfects itself. By the middle of August the female becomes a bag of eggs, which are deposited in a mass under the scale, the body of the louse shriveling, as the eggs are laid, until it is a mere speck at the small end of the scale. These eggs remain under the scale, if not destroyed, until the following spring and then hatch, completing the life history.

How this pest is spread from tree to tree is not well made out, but it is supposed that birds carry them on their feet and that large insects may transport them or that the wind may blow the young about. They are probably introduced into young orchards on the nursery stock and multiply.

Remedies.

During the winter examine the twigs and scrape off the scales, after which, wash with a strong solution of caustic soda or washing powder, applied with a stiff brush. In June, while the lice are still active, spray with an alkaline solution, or better, with kerosene emulsion.

There are several natural enemies which help to keep the insect in check. One of the most important of these is a species of mite, which preys upon the louse as well as upon its eggs. This mite is so small as to be seen only with a microscope.

Another important aid in controlling this pest is the twice-stabbed lady-bird. Both larva and perfect beetle devour large numbers of the lice. The mature form of this insect is readily recognized by its polished black wing-cases with a blood-red spot on each.

THE PEAR-BLIGHT BEETLE, OR SHOT-BORER. *Xyleborus pyri*, Peck=*X. dispar*, Fabr.

This is a native species that attacks hemlock, beech, oak, and cedar, and has transferred its depredations to apple trees in Maine. We have received from several localities specimens of apple limbs that were literally honeycombed with small channels that extended through the laburnum and heart wood to the center. The young larvæ bore into the wood, making deep channels which in small twigs interfere with the circulation of the sap, and the twigs wither, giving the appearance of blight, hence the name pear-blight beetle. The work of this beetle should not, however, be confounded with the pear-blight proper, which is caused by bacteria. The exit holes through the bark were .06 of an inch in diameter and nearly circular, looking like small shot holes. The wood was green, showing that the insect attacks the growing tree. Living wood does not appear to be essential to the life and comfort of this species, for after a period of several weeks we found in a limb that had been in a dry place in a box, young larvæ, full grown larvæ, pupæ, and perfect beetles.

Description.

So far as we know, the eggs have not been described. They must be very small and are said to be laid at the bases of the buds. We have never seen them.

When the larvæ are full grown they transform to pupæ in the burrows, and finally emerge as small beetles about one-tenth of an inch long and of a dark brown or nearly black color, with the antennæ and legs of a rusty red. The thorax is short, very convex, rounded and roughened. The wing covers are marked by longitudinal rows of punctures. The hind part of the body slopes abruptly. The beetles leave their burrows in July and deposit eggs before August.

Remedies.

As the beetles work wholly under the bark they cannot be reached by insecticides. The only way is to watch the trees during the latter part of June and July and, if blighted twigs or diseased limbs are noticed, examine the branches for small pin holes; if found, the presence of this or some related species may be suspected. The diseased limb should at once be cut far enough below the injury to include all the burrows, and burned,

to prevent the beetles emerging and attacking new trees. As these beetles live in forest trees, orchards near timber are more liable to become infested.

THE WOOLLY LOUSE OF THE APPLE. *Schizoneura lanigera*, Hausm.

Two forms of this insect are recognized by entomologists. One, known as the apple-root plant-louse, attacks the roots, producing wart-like excrescences or swellings. The other form, known as the woolly louse of the apple, is the one found in Maine. It feeds upon the sap of the trunk and branches. The two are regarded as the same species, living under different conditions. The above ground form occurs most abundantly, in this country, in New England. Entomologists differ in their opinions regarding its nativity; some accredit it to America; most are inclined to think it originated in Europe, where it is much more destructive than in this country.

This insect, in the root form, was noticed in this country as early as 1848, when thousands of trees were found so badly infested that they had to be destroyed. Since then the insect has been reported as doing more or less damage in every section of the country. The pest is distributed upon nursery stock, and the importance of carefully examining nursery stock before setting is strongly urged.

Description and Life History.

The eggs, which are very minute, are laid in the crevices of the bark at or near the surface of the ground.

The young when first hatched appear like specks of mold, being covered with fine white down. As they get older, the cottony covering becomes more distinct, apparently issuing from the pores of the skin of the abdomen and attaining considerable length. The young have beaks longer than the body and, when grown, this organ is fully two-thirds the length of the body. By means of the beak, they attach themselves to the roots or branches, and when abundant, draw heavily upon the vitality of the tree, or may even kill it.

When full grown the females are about one-tenth of an inch long, oval; head and feet black; legs and antennæ dusky; abdomen yellowish; body covered with white mealy powder; a tuft of long, easily detached down upon the hinder part. Under each patch of down is usually found a female and her young. During the summer the females are wingless

and the young are produced alive. Toward the fall the broods contain both winged females and winged males, which have not much down on them and are plump and nearly black. The fore wings are about twice as long as the narrow hind ones. These winged females fly about to other trees and lay eggs, establishing new colonies. During the early part of the season this form of the insect is found in clusters about the base of the trunk, upon suckers or twigs springing from the trunk, but in autumn they commonly attack the axils of the leaves and sometimes cover the whole under surface of the limbs and trunk, making the tree look as though whitewashed.

Remedies.

In early spring wash the tree with a strong solution of soft-soap or washing powder. Later in the season spray with kerosene emulsion.

B. Insects Affecting the Foliage.

The bud moth. *Tmetocera ocellana,* Schlieff.

This is probably one of the worst pests to apple orchards in Maine. It works in the unfolding flower and leaf buds of orchard trees, often doing great damage to the crop, besides attacking nursery stock and young trees. It seems to be on the increase in Maine and did much damage in the season of 1899. It is an European insect but is now widely distributed in the northern U. S. and Canada. Besides the apple, it feeds upon the pear, plum, cherry, quince and peach trees, and in Maine has been bred from blackberry plants.

Description.

Eggs.—Disc-shaped, transparent, flattened, usually oval or sometimes circular in outline. The center of the disc elevated, the outer flat rim attached to the leaf.

Larva.—When first hatched, greenish, with head and first thoracic segment black. It molts four times before hibernating. The half-grown caterpillar, which appears on the buds in spring, is about one-sixth of an inch long, brown, with a black head, thorax, shield and legs. When full fed, about the last of June, it changes to the pupa stage within a tube of dead leaves.

Pupa.—Light brown, about a quarter of an inch long. On the back of each abdominal segment are two transverse rows of teeth directed backward.

Perfect Insect.—A moth with three-fifths inch spread of wings. It may be known by the ash-gray color of the fore wings, which are banded across the middle with a cream white band.

Life History.

The half-grown, brown, hibernating caterpillars usually emerge from winter quarters about the time the buds begin to expand, their first appearance depending on the advance of the season, and ranging over two or three weeks. When they are out early, they gnaw into the buds. If the buds are open they crawl inside. They attack both flower and leaf buds, fastening the parts together with silken threads, forming a nest, within which they feed upon the enclosed tender flower or leaf parts. They do not confine their depredations to a single leaf or flower in the bud, but increase the injury done by sampling nearly all. They sometimes bore down the stems a few inches, killing the terminal shoots. The bud attacked turns brown, making the nest conspicuous. The caterpillars feed mostly at night for six or seven weeks and molt three times. When full grown the caterpillar forms a tube out of leaves, which it lines with thin, closely woven silk, and within it soon changes to the pupa. In about ten days the pupa works its way nearly out of the tube by the hooks on its back. The skin splits open and the moth appears. The moths are on the wing during the latter part of June and the first of July. They fly mostly at night, resting on the trees during the day time, when they are easily detected by the white bands on the wings. They live two or three weeks, during which time they mate and the eggs are laid. The eggs, which resemble small fish scales, are laid singly or in clusters, mostly at night, on the under side of the leaves. The eggs hatch in seven to ten days. The young larvæ feed upon the epidermis of the leaf, forming a silken tube for protection. After the fourth molt, which occurs the last of August or the first of September, or before the leaves fall, they leave the silken tubes and form a silken winter home (*hibernaculum*) on the smaller twigs near the buds, in which they spend the winter. The appearance of the hibernating larva in the spring completes the cycle of life.

Remedies.

Pull off and crush the withered clusters of leaves containing the caterpillars and chrysalids early in spring.

Spray with Paris green or with Bordeaux mixture and Paris green, as soon as the buds begin to swell in the spring.

THE OBLIQUE-BANDED LEAF ROLLER. *Cacœcia rosana,* Harris.

This is a native species, reported from several localities in the United States, and one of several species responsible for the destruction of the buds and foliage of apple trees. We have bred it from the leaves of the apple, currant and strawberry in Maine. It also feeds upon the plum, pear, peach, cherry, rose, and a great variety of other trees and shrubs.

Description.

Eggs.—So far as we know, the eggs have not been described.

Larva.—Length .8 of an inch; livid green when young, becoming yellowish green, reddish or brownish with age. Head oval, top of first segment yellow or brown; usually a darker green stripe along the back. The posterior half of the segments wrinkled transversely, and bearing a few minute tubercles from which single hairs arise. When mature the larva spins a silk lining to the leaf in which it lives and changes to a chrysalis of a dark brown color from which emerges the moth.

Perfect Insect.—A short, broad, flat, bell shaped moth, with about one inch spread of wing. The wings pale, reddish brown, crossed with wavy, pale brown lines and with three oblique darker brown bands, one of which covers the base of the wings, another the middle and the third a triangular spot on the front margin near tne tip.

Life History.

As soon as the leaves start, the caterpillars begin to coil up and fasten together the young leaves which they feed upon, and in which they find shelter. They attack the buds, leaves and also the young fruit, gnawing its surface or eating deep holes into it. They are full grown the last of June or early in July, when each lines its leaf house with silk, and changes to the chrysalis, from which the moth emerges the last of July. There is a second brood in August. We know nothing of its egg laying habits, or how or where it spends the winter.

Remedies.

The same remedies may be used for this insect as for the bud moth.

THE LESSER APPLE LEAF FOLDER. *Teras minuta,* Robr.

This is another of the small moths that do damage to the buds and leaves of the terminal shoots of the apple tree. It is particularly bad in Maine. It is said to be specially bad in nursery stock, and young orchards, but large trees also suffer. This is a well known cranberry insect and may get into orchards from the bogs.

Description.

Eggs.—The eggs, so far as we know, have not been described.

Larva.—A small, greenish yellow, active caterpillar, with a pale brown head. When disturbed it seeks the more secluded parts of its burrow, or if too much molested, wriggles out and drops to the ground.

Chrysalis.—Within the folded leaf, the larva spins a silken web and changes to a brown chrysalis, three-tenths of an inch long. There is a characteristic knob-like projection from the head end of the chrysalis.

Perfect Insect.—A small moth, with one-half inch spread of wing. There are three broods and the insect is dimorphic, the moths of the third brood being very different in color. These dimorphic forms were thought to be different species until carefully bred and studied. The moths of the first two broods have the head, thorax and fore wings a bright orange color; the hind wings, body and legs are whitish with a silken lustre. The moths of the third brood have the fore wings of a uniform ash-gray, or slate color with reddish luster by oblique light; hind wings light colored and semi-transparent.

Life History.

The gray-colored moths of the third brood hibernate in some sheltered place during the winter. In the early spring they come forth and deposit their eggs on the buds or unfolding leaves. The eggs hatch in a few days and the larvæ crawl between the unfolding leaves and begin feeding upon them, often fastening one or more leaves together by a silken web and living within them. They live upon the epidermis and pulp, but sometimes gnaw holes in the leaves, and sometimes forsake the nest, to feed on adjacent exposed leaves. When mature they spin a silken lining to the leaf and change to the chrysalis, where they remain about a week, and early in May the orange-colored moths of the first brood come forth. The larvæ of the second brood appear the last of May or early in June, and the moths the last of June or in July. The moths of the third brood appear in August, and hibernate, completing the round of life.

Vulnerable Points and Remedies.

The young larvæ of all the broods are exposed when they first hatch and before their leaf shelter is made. The same remedies apply to this insect as to the bud moth.

THE FOREST TENT CATERPILLAR. *Clisiocampa disstria,* Hübner.

There are two tent caterpillars in the eastern United States; the apple tree tent caterpillar, *Clisiocampa Americana,* and the forest tent caterpillar, which was called by Prof. Harris *Clisiocampa sylvatica,* but in recent literature is known as *Clisiocampa disstria.* Both species are common in Maine but are often confounded. Though similar in their life history, they are readily separated by differences in the egg clusters, caterpillars and moths.

Distinguishing Characteristics.—Egg clusters of this species, the same diameter throughout, docked off squarely at the ends; caterpillars with a row of spots along the back; oblique lines on the wings dark colored; web inconspicuous, closely attached to the limbs or trunk and easily overlooked. Insect restless, wandering from tree to tree. Occurs in orchards but, being a general feeder, is more commonly found on forest or shade trees, from which habit it receives its common name.

Description.

Eggs.—The egg clusters, composed of about 300 to 400 eggs, are attached to the terminal twigs of the food plant. They are of the same diameter throughout and cut off squarely at the ends. The eggs are creamy white, rounded at the base, enlarging upwards, narrowing again at the top and terminated by a circular rim on the border and a sunken spot in the center. They are held to the twig and to each other by a brown varnish, which also covers the egg clusters, protecting them from the weather and probably from their enemies.

Larva.—The eggs hatch in the early spring, usually about the time the buds are bursting. The time, however, varies with the exposure of the egg clusters to the sun, and also with the season. In Maine they are hatched the last of April or early in May. Sometimes, during continued warm weather, the eggs hatch before the leaves start, and cold weather comes on afterwards. The young larvæ are very hardy, however, and are not often killed. We have kept them alive in breeding cages for three weeks without food. They will eat the varnish on egg clusters. As soon as hatched they spin a web wherever they go, possibly to enable

them to retrace their steps. Soon the branches are lined with these silken paths along which they travel in search of food. They shed their skin (molt) four times, changing color and markings in the first three. They are full fed in about six weeks, though the growth may be hastened or retarded by the weather or food supply. At this time they may be seen wandering about for a suitable place to spin their cocoons.

Cocoon.—The larva spins a whitish-yellow cocoon, resembling that of the apple tree tent caterpillar, and by preference folds it in a leaf, but often attaches it to loose bark or about fences, houses or other places of concealment. Inside of the cocoon the caterpillar changes, in two or three days, to the chrysalis. In two or three weeks the moths emerge.

Perfect Insect.—A brownish yellow moth, expanding an inch and a half or more. The fore wings marked by two oblique brown lines, the space between them usually darker than the rest of the wing. The moths eat nothing. After they have mated and laid their eggs, they die, completing the life history.

Remedies.

(a) Collect the egg clusters in winter when the trees are bare.

(b) While young the caterpillars can be destroyed by spraying with Paris green, but when half grown the amount of poison they get in feeding will not kill them.

(c) After the third molt, they collect in bunches, on the trunks and branches, and can be reached by hand or by spraying. A solution of one pound of washing powder in four or five gallons of water, applied to the bunches by means of a swab attached to a long pole, has proved effectual.

(d) After the caterpillars begin to collect in bunches, or even before, spread a sheet of canvas under the tree. Climb the tree and with a padded mallet suddenly jar the branches on which they rest, and they will fall on the canvas and can be swept up and destroyed. This method is applicable to both orchard and shade trees, and would recommend itself to town authorities, as by the employment of a few men for a few days in June, in Maine, the shade trees could be protected.

(e) Put bands of cotton, or of tarred paper bearing a ring of a mixture of equal parts of sulphur and lard, around the trees, or use any other practical method to prevent them from ascending the trees. In our own experience a band of paper covered with the lard and sulphur mixture has proved an absolutely effectual barrier.

(f) The moths are night fliers and are attracted by electric lights and many are probably destroyed this way. The cater-

pillars, cocoons and moths should be destroyed by hand whenever possible.

(g) The city of Rochester, N. Y., has successfully enlisted the services of the school children in protecting the city shade trees. Pride in one's city adornment could be thus stimulated in pupils, and by collecting the egg clusters, caterpillars, cocoons and moths, a valuable and practical lesson in nature study would be learned. It would pay town authorities to offer a small bounty, if need be, to stimulate the collecting. All specimens collected should be burned.

Remarks.

For a fuller consideration of this insect and illustrations of all the stages in its life history, the reader is referred to Maine Experiment Station Report, 1888, p. 164; 1889, p. 188; 1890, p. 138, and 1897, p. 173; or to the Maine Agricultural Reports of the corresponding years.

THE APPLE TREE TENT CATERPILLAR. *Clisiocampa Americana*, Harris.

This insect is a native of North America and occurs wherever apples are grown. It has given more or less trouble to apple growers since the early settlement of the country. While it prefers wild cherry, and selects the apple as second choice, it feeds upon plum, peach, rose, and other members of the rose family; also upon the oak, poplar, willow, birch, witch hazel, beech, etc.

Description and Life History.

Eggs.—Dull gray; the upper end circular with a dark spot in the center. They are laid in clusters round the twigs and covered with varnish to protect them from the weather. There are from fifty to two hundred and fifty in a bunch.

Larva.—When first hatched they are dull black and sparsely covered with gray hairs. They appear about the time the leaves start, but if ahead of them, may feed for a time upon the varnish covering the eggs. They molt about six times. The larvæ soon begin to spin a web which increases in size by additional layers of silk as the worms grow, until it is sometimes ten inches or more across. The worms remain in the tent at night, during stormy weather and when not feeding, unless the weather is warm, in which case they may often be seen upon the outside, literally covering the web. They march in military order twice a day from the nest to feed, once in the morning and once in the afternoon.

They pave their roads with silk and follow along them to the leaves. When mature, each worm will consume two leaves a day and an average of five hundred leaves would be required for a colony. There are often several webs in a tree. The effects are to rapidly defoliate the tree and draw heavily upon its vitality to produce new leaves. The caterpillars require about six weeks to mature and are then about an inch and three-fourths long. The worms have a "white line along the back, then a yellow line dotted with black, then a black stripe marked with blue and yellow dots, then a wavy yellow line dotted with black, then a blue stripe dotted with yellow, then a broken white line; head black, under side of body black, the body covered with yellowish or whitish hairs." When mature the larvæ leave the tree and wander about in search of a place to spin their cocoons. They prefer the loose bark of trees, or the under side of fence caps, and will enter sheds and porches and climb the sides of houses and transform under the edge of clapboards, window caps and eaves. When the orchard is near they become a nuisance by entering the house.

Cocoon.—Oblong oval, light yellow, formed of a loosely woven, outer covering and a dense, tough, inner coat. The larva enclosed becomes a brown chrysalis and in about three weeks the moth appears.

Perfect Insect.—A moth of a pale, dull, reddish or reddish-brown color. The fore wings crossed by two oblique, parallel, dirty-white lines. The female is larger than the male. The male has feathery antennæ. The moth has no mouth and takes no food and lives only a few days. Its office is to lay the eggs.

Remedies.

Most of the remedies suggested for the forest tent caterpillar are equally valuable in controlling this insect. As this species does not migrate, the jarring and the protective bands are useless.

THE FALL WEB WORM. *Hyphantria cunea,* Drury.

The fall web worm is a native insect which has from time to time done great damage to forest and fruit trees. It is a general feeder, having been observed to feed upon over one hundred different species of trees, shrubs and herbs. It makes a web which is sometimes very conspicuous, attaining dimensions of several feet. The web can readily be told from that of the apple tree tent caterpillar.

We found this insect abundant in western Maine on July 5 when the webs were already quite conspicuous. In "Forest Insects," issued from the U. S. Department of Agriculture, Dr. Packard, on page 244, says: "The name fall web worm is most

expressive for New England and other northern states where the insect is single brooded, appearing there during August and September, while in more southern regions it is double brooded." Though we have not traced this insect through its life history in Maine, and cannot positively say that there are two broods, yet the fact that the webs were conspicuous and the larvæ fully three-fourths of an inch long early in July, would indicate two broods in western Maine.

Description.

Egg.—About one-sixth inch long, bright golden yellow, globular, ornamented with numerous regular pits, which, according to Packard, give it, under the magnifying lens, the appearance of a beautiful golden thimble.

Larva.—Pale yellow when young, with two rows of black marks along the body, a black head and sparse hairs. Full grown larva usually pale yellowish or greenish with a broad, dark stripe along the back and a yellowish stripe along the side, covered with whitish hairs that spring from black and orange yellow warts. The caterpillars are somewhat variable as to depth of color and marking, even on the same tree. The fall brood is generally darker colored than the spring brood.

Cocoon.—Thin, almost transparent, composed of a slight web of silk intermixed with a few hairs from the caterpillar, or sometimes mixed with sand when the cocoon is spun in the soil.

Pupa.—Length .6 inch, breadth in the middle, .23 inch; dark brown, smooth, polished, faintly punctuate, and bulged a little all around in the middle.

Perfect Insect.—A moth which varies greatly in size and color. These color varieties have received different names by entomologists, but are now reduced to *H. cunea,* Drury. The most common form is white or slightly fulvous with white wings, but the wings show variations from pure white to those profusely dotted with black and brown. Front thighs tawny yellow, sometimes marked with a large black spot; feet blackish; expanse of wings one and one-fourth to one and two-thirds inches. Male moth usually smaller with the antennæ doubly feathered beneath. The antennæ of the female possesses two rows of minute teeth.

Life History.

The female deposits her eggs in clusters, laid in regular rows or smaller irregular patches, on either side of the leaves, usually near the end of a branch. Each female lays on an average about five hundred eggs. Those for the first brood are deposited by the last of May or during June, and the time required for them to hatch depends upon the weather. Under favorable circumstances they mature in about ten days, or those of the second

brood in eight days. As soon as the caterpillars hatch they spin a small silken web which soon becomes conspicuous. Under this they feed together, upon the upper surface of the leaves. As they grow, other leaves and branches are included until the web reaches considerable size and contains dead leaves and the molt skins of the larvæ. If their food supply gives out, they quit the web and drop to the ground and crawl directly toward other trees with almost unerring instinct, or, when disturbed, let themselves down by a thread and by this regain the tree when the danger is past.

When full grown they are nearly two inches long and leave the web and wander about for suitable places to spin their cocoons. They select crevices in bark, the angles of tree boxes, rubbish about the base of trees, and other similar situations, while the fall brood prefer to bury themselves in the earth if possible, but adapt themselves to circumstances. They soon spin their cocoons. The pupæ contained in these hatch into the second brood of moths about the first of August, and the moths lay eggs which hatch into caterpillars that feed, mature, and spin their cocoons during August and September. The insects invariably spend the winter in the chrysalis state in the cocoon, and the following spring the moths emerge and lay their eggs, thus completing the life history.

Remedies.

Spray with Paris green before the insect makes much headway. If there are but few webs on the tree, cut off the branches and burn. Another effective remedy is a strong alkali, whale oil soap, or washing powder solution applied with a swab.

There are several predaceous insects which attack the larvæ, the most important being the spined soldier bug, *Podisus spinosus* (Dallas).

THE LIME TREE WINTER MOTH. *Hybernia tillaria,* Harris.

This is a native species often associated with the fall canker worm, which it resembles very much in its life history. It seems to remain and do damage when the fall canker worm has disappeared.

Description.

Eggs.—Pale yellow, oval and marked with a network of raised lines. They can be distinguished from the eggs of the canker-worm by their color and form. (See Report Maine Experiment Station, 1888, p. 167, Fig. 20).

Larva.—When full grown, about an inch and a quarter long; head dull red with a V-shaped mark on the front; yellow above and marked with many longitudinal black lines; the under side paler. Like the larva of the canker worm, it is a span or inch-worm, but it is larger than the caterpillar of that species.

Female Moth.—Wingless, spider-like, yellowish white; sides marked with black dots. Each ring of the body, excepting the last, which has only one, bears two black dots. Head black in front; antennæ thread-like. Ovipositor jointed and retractile; legs ringed with black. The larger size, the spotted back, and the black rings on the legs readily distinguish this from the wingless females of the fall and spring canker worms.

Male Moth.—Expanse of fore wings an inch and a half; color rusty buff, sprinkled with brownish dots and with two transverse, brown, wavy, lines, the inner most distinct. Between the bands and near the anterior edge is usually a brownish dot; hind wings paler; body color of fore wings; antennæ feathered. Like most of the moths of the inch worms, the wings are very delicate. The moths of the canker worm are on the wing at the same time, but they are smaller and are thus readily distinguished.

Life History.

The eggs, which are laid in situations similar to those of the canker worm, hatch early in the spring and the young larvæ feed upon the foliage of the apple tree, basswood, elm, hickory, etc., and when full grown, about the middle of June, they usually let themselves down by a silken thread, enter the ground about five or six inches and form a little oblong cell, within which they change to the chrysalis state. In October or November (sometimes not until the following spring), the moths appear. The wingless females climb the trees or other objects where they meet the winged males, pair and soon deposit the eggs in clusters, usually upon the branches of the trees they have infested, completing the life history.

Remedies.

The life history of this species is so nearly like that of the canker-worm that the remedies suggested for that insect are applicable to this. It has never done as much damage as the canker worm, but it is capable of doing much injury to the foliage of apple trees.

THE APPLE LEAF BUCCULATRIX. *Bucculatrix Pomifoliella*, Clemmens.

This moth was described by Clemmens in 1860. It is known to be widely distributed, having been reported from Texas, Missouri, Massachusetts, New York, and now from several localities in Maine. It has done considerable damage to the foliage of apple trees especially in New York.

Description.

Eggs.—So far as we know, the eggs of this species have never been described. They must be quite small as the cocoons of this diminutive moth have been mistaken for insect eggs. They are said to be laid upon the leaves.

Larva.—About one-half inch long when mature, cylindrical, tapering at both ends. Joints of the body rounded and prominent, color dark yellowish, with a greenish tinge and reddish shades on the anterior segments. Body armed with short black hairs which are more numerous on the back of the first segment. Head small, brown and ellipsoidal. The larvæ are active and when disturbed suspend themselves by a silken thread.

Cocoons.—Dirty white, slender, about one-fourth inch long, ribbed longitudinally by about six prominent ridges, oblong, tapering at both ends, flattened on the side to which it is attached. Usually fastened to the twigs and branches in groups.

Chrysalis.—Dark brown, rough, punctured on the back, about one-tenth of an inch long. When ready to transform, the chrysalis works itself partly out of the cocoon and the moth comes forth.

Perfect Insect.—A small moth that has only about one-fourth inch expanse of wings. Fore wings whitish, tinged with pale yellow and dusty brown. On the middle of the inner margin is a conspicuous oval brown spot; a wide streak of the same color on the opposite margin extending nearly to the end of the wing, where it tapers and points to a small circular brown spot near the tip.

Life History.

This insect spends the winter in the pupa state in the cocoon, usually attached to the twigs and branches of the host plant. There is reason to believe that the larvæ, when full grown, sometimes desert the host plant and form their cocoons on other plants close by. We have seen cocoons on the side of a building in Maine. About the time the leaves unfold, the moths come forth and lay their eggs upon the tender foliage. The larvæ are full grown in July. The specimens sent us in July were in the

larval form and went into the chrysalis state in August and emerged the following spring, a fact which would indicate only one brood in Maine. Prof. Riley believed that there are two or three broods in the latitude of St. Louis, Mo. In the latitude of New York, Prof. Lintner states that there are two broods, one in July and one in September.

In September or October the cocoons in which the pupæ spend the winter are formed. The larvæ feed externally upon the foliage, at least the leaves we have received had the upper epidermis and pulp eaten away in patches, the veins and lower epidermis intact.

Remedies.

(a) Jar the trees when the larvæ are full grown and they will suspend themselves by threads and can be swept down by a broom and killed by hot water or crushed.

(b) Apply kerosene emulsion with a spraying pump in winter, to the branches that bear the cocoons. The same application might be made for the first brood when the foliage is on.

(c) If in small numbers, the cocoons may be removed during the winter months by hand.

(d) Spray with Paris green, as for other leaf eating insects. This small moth is preyed upon by several parasites that attack the larvæ and hold the pest in check, and some of the cocoons probably suffer somewhat from inclemency of the weather. Possibly birds may eat them, but we find no record of observations.

THE WHITE-MARKED TUSSOCK MOTH. *Orgyia* (*Notolophus*) *leucostigma,* Sm. & Abb.

During the past ten years specimens of the above insect, in the egg, larval and wingless female stages of its life history, have been received at the Experiment Station from various parts of the State. It is a native species and is apparently widely distributed, having attracted considerable attention as an apple insect.

Description.

Eggs.—Three or four hundred in a mass, attached to the empty grayish cocoon previously occupied by the female moth. Egg mass convex, smooth, grayish-white; composed of several layers of eggs, with a frothy, gelatinous material between them.

Larva.—When mature, over one inch long; bright yellow; head, and two small protuberances on the back carrot-red; back ornamented with four cream-colored brush-like tufts; two long black plumes near the head and one near the posterior end of the body; sides clothed with yellow hairs; brown or black stripe on the back, and a dusky stripe on each side.

Cocoon.—Gray; spun on the inside of a leaf. Texture loose and the silk interwoven with numerous hairs from the caterpillar. Chrysalis, enclosed in the cocoon, oval, brown or sometimes whitish below, covered with whitish hairs or down.

Perfect Insect (female).—Wingless or wings mere rudiments; light gray, oblong-oval; body distended with eggs; legs long.

Perfect Insect (male).—Winged, expands an inch and a quarter; fore wings crossed by wavy bands of darker shade; a small black spot on the outer edge of the wing toward the tip; beyond it an oblique blackish stripe, near the outer hind angle a minute white crescent; body gray, with a small black tuft near the band of the abdomen; antennæ feathered.

Life History.

During the winter months there will occasionally be found in the orchard, dead leaves attached to the branches of the trees. Upon examination these will usually be found to contain an empty, gray cocoon with a mass of eggs attached to it, as described above. These eggs hatch, in Maine, about the first of June, or earlier farther south. The young larvæ at once begin to devour the leaves of the tree. When disturbed they lower themselves by means of a silken thread which they climb when danger is past. The beautiful caterpillars described above feed about two months and then spin their cocoons. The moths soon emerge and the wingless females, being little more than animated masses of eggs are sluggish. The males, having wings, are able to fly, and they meet the females while resting upon the empty cocoon to which the mass of eggs is finally attached. If there is only one brood, the eggs do not hatch until the following spring; if two broods, the eggs soon hatch, producing the second brood of caterpillars which complete their growth late in the season and enter the chrysalis state. The moths soon emerge, mate, and the female lays the eggs on the cocoon, completing the life history.

Remedies.

Collect and destroy the eggs and cocoons during the winter. Spray with Paris green, or with Paris green and Bordeaux

mixture. Usually no special treatment is required for this insect if the trees are thoroughly protected from the tent caterpillar.

THE FALL CANKER WORM. *Anisopteryx pometaria,* Harris.

This insect has been very bad at times in Maine, doing much damage to fruit and shade trees. Parasites and other enemies soon control it, however, so that it does not usually do damage in the same locality more than two successive seasons.

Description.

Eggs.—Grayish, flattened above, with a central puncture and a brown circle near the border. Each female lays 100 or 200 eggs in rows arranged in clusters on the twigs or branches, or on fences and buildings, usually in exposed situations.

Larva.—Pale olive green when young, but varying in color, when grown, from greenish yellow to dark brown. Dorsal band broad, brownish; lateral lines three, white, the middle one paler; broad brown bands below the lateral lines, and below that a broad white band. Under side, flesh-colored; head brown.

These caterpillars belong to the group of inch or measuring worms, because they alternately loop and extend the body in moving. When at rest they sometimes assume an erect position, and can hardly be told from twigs. When full grown they are about one inch long. When mature they crawl down the trunk or let themselves to the ground by a silken thread, and burrow to a depth of from two to six inches. They make a tough cocoon of buff colored silk interwoven with earth, and in twenty-four hours turn into the chrysalis.

Chrysalis.—Light greyish brown; about half an inch long. The male slender, and provided with wing cases; the female larger, and without wing cases.

Perfect Insect (male).—A moth provided with wings, the fore wings brownish gray, glossy, crossed by two whitish irregular bands, the outer one enlarging into a pale spot at the apex. Hind wings grayish brown with a white band crossing them, and in the center a faint blackish dot.

Perfect Insect (female).—Wingless; uniform shining ash color above, gray beneath; length three to four-tenths of an inch. Sluggish of movement and spider-like in appearance.

Life History.

The eggs hatch about the time the buds on the apple trees expand. The young worms feed upon the tender leaves, seeking shelter within the expanding flowers or buds when the weather is wet and cold. They eat holes in the leaves while young, but

when older devour the whole pulp of the leaf, leaving only the veins and midrib. They feed for about four weeks, and when numerous so injure the foliage as to give the trees the appearance of having been scorched with fire. They have done great damage to the foliage of trees along highways. While letting themselves down to the ground they are often swept off by carriages and carried long distances.

The larvæ enter the ground, spin cocoons and are changed immediately into the chrysalis state, from which, during the fall, winter and following spring, they emerge in the perfect form, completing the life history.

Remedies.

Since the females are wingless, they may be trapped and destroyed by placing bands of tarred paper about the trunks of the trees and smearing these with printer's ink, tar mixed with oil, or refuse molasses. As these materials soon dry, however, they must be frequently renewed, or the insects will be able to cross. Tin or lead troughs, containing crude petroleum, are also used with some success. The most effective treatment, however, is to spray with Paris green, just as soon as the insects appear. Delay in applying the poison is often fatal to success.

There are numerous natural enemies, including a small mite, which destroys the eggs; a species of Microgaster,—a small four-winged fly,—parasitic upon the larvæ; and a species of tachina fly, also parasitic upon the larvæ.

THE APPLE TREE APHIS. *Aphis mali,* Fabr.

This insect was originally from Europe, but is now a pest in apple orchards throughout the northern United States and Canada, often causing serious losses in young orchards and nurseries.

Description.

Eggs.—Minute, oval, light yellow or greenish when first laid, gradually changing to shining black.

Young Insects (male).—Head, thorax and antennæ black; neck usually green; abdomen short, thick, oval, bright green; sides with row of black spots; nectaries and tail-like appendages black; wings transparent with dark brown veins.

Perfect Insect (female).—Length of wingless form less than one-tenth inch; body oval, pale yellowish green, often striped with deeper green; eyes and tail appendages black; honey tubes green. The winged female resembles the male in color.

Life History.

The eggs are deposited in the autumn in the cracks of the bark of twigs and at the bases of the buds. The eggs hatch when the buds begin to expand and the lice locate themselves on the young buds and leaves by means of their beaks and feed upon the juices. The spring brood is composed of females and is about ten days reaching maturity. Each louse gives birth to living young, producing about two a day for two or three weeks, and then dies. These young become mothers in about ten days. This process is continued through the season, there being many generations, mostly wingless females, without the appearance of males. Winged females are sometimes produced which, migrating to other trees, spread the pest. Late in the season males and females are produced in the same brood and, after mating, eggs are laid to perpetuate the species, thus completing the life history.

Remedies.

Wash the trees during winter or early spring with a strong solution of soft soap, or of washing powder, to destroy the eggs. Later in the season, if the aphids become numerous, spray with kerosene emulsion or with a strong decoction of tobacco, made by pouring 1 gallon of boiling water over a pound of tobacco stems or leaves.

There are many natural enemies of the aphis which should be encouraged. Among these are seven or eight species of lady-birds, and the larvæ of syrphus flies and of chrysopa or lace winged flies.

THE RED-HUMPED APPLE TREE CATERPILLAR. *Œdemasia concinna*, S. & A.

This species is native to the United States and has been reported from several localities in Maine as doing considerable damage to the foliage of apple trees. It is said to be widely distributed in this country, but is not an abundant species. It

prefers the apple, but is known to feed upon the plum, cherry, rose, thorn, and pear,—plants belonging to the rose family.

Description.

Eggs.—The eggs, so far as we know, have not been described.

Larva.—When full grown, the larvæ are often an inch and a quarter long. They may be known by the coral-red head and a hump of the same color on the fourth ring or segment from the head. The body is striped lengthwise with narrow yellow, white and black lines. There are two rows of black spines along the back, and rows of shorter black spines on the sides. Each spine bears a fine hair. The spines on the coral red hump are more prominent than the others. The hinder end of the caterpillar tapers and is usually elevated when the insect is at rest. When handled, a fluid with a strong acid smell is emitted. This is so offensive that the insects are never eaten by birds.

Perfect Insect.—A moth which measures from an inch to an inch and a quarter across the wings. The fore wings are dark brown on the inner, and grayish on the outer margin. There are several longitudinal streaks along the margin, also a dot near the middle and a spot near the angle, all dark brown. The body is light brown, and the thorax of a darker shade.

Life History.

The moths are on the wing late in June or in July. The female deposits her eggs on the under side of a leaf, in a cluster, usually during July. They soon hatch into small caterpillars. These caterpillars, while young, feed upon the tender tissues of the under side of the leaf, leaving the upper surface unbroken, but when large they devour greedily the whole leaf, excepting the midrib. They reach maturity during August and September. There is but one brood in the northern states. In the broods further south, the caterpillars feed in bunches and when not feeding remain close together. When mature they descend to the ground and hide under leaves or rubbish, or sometimes burrow a little into the ground and slowly change to the chrysalis state, where they remain until the following spring, when the moths appear, completing the life history.

Remedies.

As these caterpillars go in flocks, and when not feeding remain close together, they may easily be destroyed by cutting off the branch on which they appear and burning it. They may also be destroyed by jarring the limb, and, when they fall to the ground,

trampling them under foot. Spraying with Paris green is also effective, but poison should be used with caution on bearing trees. It is said that ichneumons are parasitic upon them and hold them in check.

THE CECROPIA EMPEROR MOTH. *Platysamia cecropia,* Linn.

This is a native species and the largest moth found in the United States. It is widely spread and a general feeder. It is a well known apple insect, and, though not abundant, attracts attention on account of its large size and voracious appetite. It has been reported in its various stages from every part of Maine.

Description.

Eggs.—Nearly one-tenth of an inch long, almost round, dull creamy white, with a reddish streak near the middle.

Larva.—When first hatched, black with shining black knobs on the body from which arise black hairs. It molts several times in coming to maturity. When full grown it is from three to four inches long and pale green. There are coral red warts on the third and fourth segments, yellow warts on the back of the other segments, except those on the second and terminal, which are blue like the smaller tubercles on the side.

Cocoons.—About three inches long, pod-shaped, rusty grey or brown and firmly attached to one side of a twig. Composed of two layers of silk, an outer loose, papery, fibrous one and a densely woven inner one which contains the brown chrysalis.

Perfect Insect.—A moth with from five to seven inches spread of wing. Both the front and hind legs are rich brown. About the middle of each wing is a kidney-shaped white spot shaded with red and margined with black. Near the tips of the fore wings is an eye-like spot containing a bluish white crescent.

Life History.

The moth lays from two to three hundred eggs, usually in pairs, firmly fastened to the under side of the leaves of the host plant. The eggs hatch in a week to ten days, the young larvæ first feeding on the empty egg-shells. They have a ravenous appetite, grow rapidly, and consume a large amount of food. When nearly mature, a few on a young apple tree may in short time strip it of leaves. The larvæ, when full grown in the fall, spin their cocoons, attaching them to the twigs of shrubs or trees on which they feed. Their great size makes them conspicuous objects after the leaves fall. The following spring, in May or

June, the moths appear and soon mate, completing the life history.

Remedies.

The larvæ and cocoons are not abundant, and are so conspicuous that hand picking is the most satisfactory treatment.

C. Insects Affecting The Fruit.

THE CODLING MOTH. *Carpocapsa pomonella,* Linn.

The codling moth is probably native to southeastern Europe, the native home of the apple. It was introduced into the United States probably in apples or pears, early in the history of the country, but it was not noticed until 1849, its work previously having been referred to the plum curculio.

It is found in most of the apple growing countries of the world and is widely distributed in Maine, being one of the worst apple insects. The larvæ, particularly of the second brood, are often in apples when marketed, and crawl out and go into the pupa stage when the apples are stored or exposed for sale. It is not uncommon to see the moths in the spring in apple outhouse cellars, or on the windows of stores and houses.

While the codling moth is more particularly an apple insect, it feeds also upon pears, wild haws, crab apples and quinces, of the pome fruits, and upon plums, apricots and cherries of the stone fruits. Specimens have been reared from the fruit of a species of screw bean and from the seed buds of roses.

Description.

Egg.—A thin scale, slightly smaller than the head of a pin; whitish, often with a yellowish tinge, semi-transparent, looking like a minute drop of milk on the skin of the fruit.

Larva.—Whitish, flesh-colored or pink; one-sixteenth of an inch long when hatched; three-fourths of an inch long when full grown; three pairs of true legs and five pairs of false legs; head, first thoracic and anal segments brown; body armed with a few short hairs arising from more or less distinct black spots.

Cocoon and pupa.—When mature the larva spins, in a day, a thin tough silken cocoon, the inner layer thin and white, the outer layer mixed with pieces of the bark or substance on which the cocoon rests. Within the cocoon, or later, the larva changes to the brown pupa.

Moth.—Spread of wing about three-fourths of an inch. Front wing crossed by numerous gray and brown lines, which are often wavy, the hind angle marked by a large, dark brown spot streaked with bronze or gold. The hind wing light greyish-brown with a darker margin. The males have a pencil of long black hairs in a furrow on the upper surface of the hind wing, and on the under side of the front wing an elongate, narrow, black spot.

Life History.

The eggs are laid on the surface of the fruit, on its stem, or on the adjacent leaves. Between the middle of May and the middle of June, a week or two after the blossoms have fallen and the fruit is from a half-inch to an inch in diameter, the young larvæ crawl about on the surface of the fruit. The most of them find their way into the blossom end, where they remain feeding for several days, and finally bore to the core of the fruit. They are full grown in about three weeks, when they make their exit channel to the surface. After feeding a few days near the surface, they emerge and usually spin cocoons under the loose bark of the trunk of the tree. Those designed for the first brood change soon to the pupa and the moths emerge in about two weeks, to lay eggs for the second brood. Those that go into the cocoon in August, and later, remain in the larval state in the cocoon during the winter and emerge as moths the following spring. In Maine only part of the first brood transform to moths the same season. When the moths appear, whether the same season or the following spring, the life history is complete.

Remedies.

As soon as the blossoms fall, spray the trees with Paris green, or with Paris green and Bordeaux mixture. The fallen fruit should be gathered and destroyed. Hogs or sheep may be kept in the orchard for the purpose. Owing to the protection afforded by the apple, the larvæ are particularly free from natural enemies. There are, however, two species of ichneumon flies which are occasionally found as parasites.

THE PLUM CURCULIO. *Conotrachelus nenuphar,* Herbst.

The plum curculio is a native of this country and originally fed upon the wild plums, which it still infests. Both males and females puncture the fruit to feed on it, but only the latter make

the crescent-shaped cuts. This insect is known to infest the plum, peach, nectarine, apricot, cherry, apple and pear. From ten to twenty-five per cent of the early apples examined in July, showed the characteristic cut.

After the first of August but few cuts, made by this insect, were found and we are led to believe that they prefer the earlier varieties, and that the apples punctured do not mature. A large per cent of the larvæ which hatched did not reach maturity. We, however, succeeded in transforming enough to identify the species. It would seem that the plum curculio does not flourish well in the apple and attacks it in the absence of its favorite fruit. The decline in the cultivation of plums, due to the ravages of this pest, and the black knot, will account for its attacking apples.

Description.

Egg.—Oblong, oval, pearly white. Visible to the naked eye, and can be found readily by examining the crescent-shaped cut made by the female.

Larva.—When young, tiny, soft, footless; head distinct, horny. When full grown it is usually of a glossy yellowish white, but varies in color with the food; head light brown or yellowish. Along each side is a light line, below which is a row of black bristles and above it a less distinct one, and toward the hind extremity a few pale hairs; length about two-fifths of an inch. The larva is so transparent, the internal organs are plainly seen through the skin, imparting a reddish color to the central parts of the body.

Perfect Insect.—A beetle, belonging to the family of insects known as weevils or snout beetles. It is blackish or greyish, rough, with a black shining hump on each wing case near the middle, behind which is a dull ochre-yellow band marked with whitish about the middle; each thigh has two small teeth on the under side; snout short. Length of insect about one-fifth of an inch.

Life History.

The beetles hibernate in secluded spots during the winter and appear on the wing about the time the plum trees blossom. As soon as the young fruit forms, the eggs are deposited. The female, when about to lay an egg, makes a minute incision with her jaws and then, inserting the snout, enlarges the hole sufficiently to hold the egg, turns around, deposits the egg, thrusts it to the bottom of the hole with the snout, then cuts a crescent-shaped incision around one side of the opening.

Only one egg is laid in a place, though on the apple, several punctures may occur on the same fruit. Each beetle lays from fifty to one hundred eggs and deposits from five to ten a day. The time of depositing eggs by early and late beetles probably occupies about two months. The first apples examined, July first, were badly punctured and no new cuts were found after the twentieth of the month. The eggs hatch in a few days and the larva is full grown in from three to five weeks. The infested apples or plums usually drop to the ground before the larva is grown and when mature it leaves the fruit, enters the ground four to six inches, forms an oval cavity, changes to the chrysalis, and in from three to six weeks the perfect insect is formed and makes its way to the surface, completing the life history. There seems to be some reason for believing that a few remain in the ground all winter. The specimens we transformed appeared in September, about four weeks from the time the larva was mature. We are inclined to believe that those apples in which the egg hatches and the larva grows, drop early. Abortive cuts shrivel and deface the fruit and check its growth, but it may mature.

Remedies.

Spraying with Paris green early in the season and after the blossoms fall is sometimes practiced. On a few trees in the garden, the jarring method employed for plum trees may sometimes be used to advantage. There are many insects which devour the curculio larva as it escapes from the fruit. Foremost among these are two or three species of common ground beetles. The larva of the soldier beetle is also a useful destroying agent, often entering the fruit while still on the tree, in search of its prey.

THE APPLE MAGGOT. *Trypeta (Rhagoletis) pomonella*, Walsh.

This is a native species which originally fed upon thorn plums, and probably wild crab apples, and has transferred its depredations to cultivated apples. It first attracted attention nearly fifty years ago, and as early as 1867 was doing great damage in New York, Massachusetts, Connecticut and Vermont. Since that time it has spread and increased until it is now widely distributed and regarded as one of the worst pests of the apple.

PLATE I.

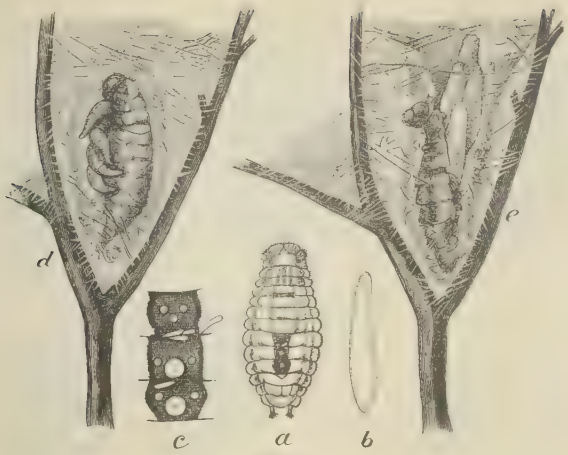


FIG. 1.

FIG. 2.

FIG. 5.

FIG. 3.

FIG. 4.

FIG. 6.

FIG. 7.

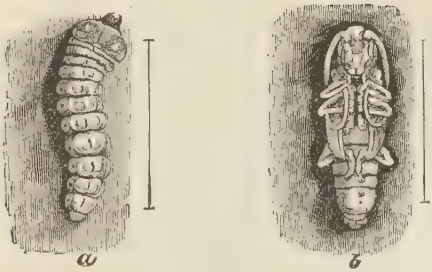


FIG. 1.

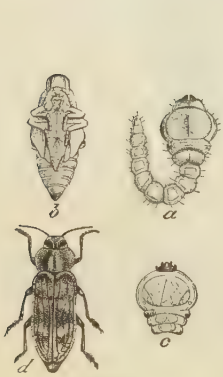


FIG. 2.

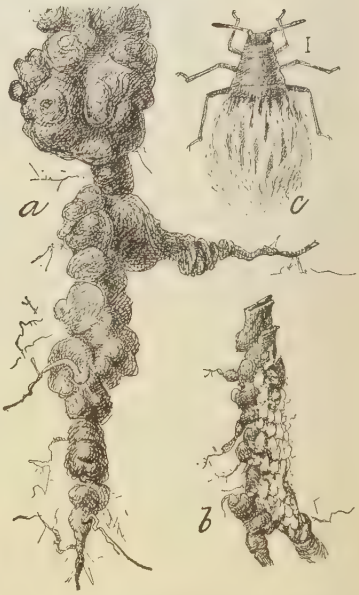


FIG. 3.

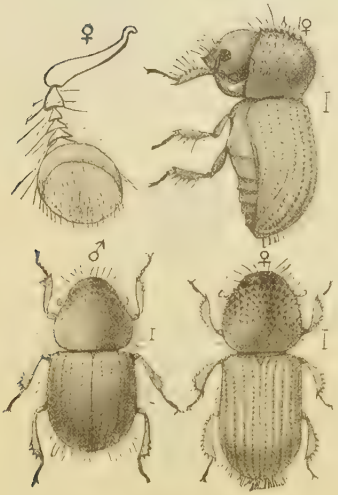


FIG. 4.

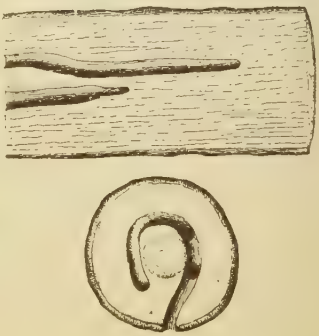


FIG. 5.

PLATE III.

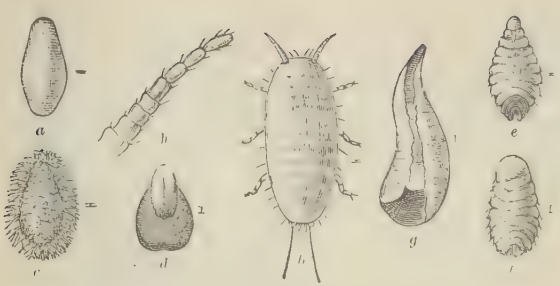


FIG. 1.

FIG. 2.

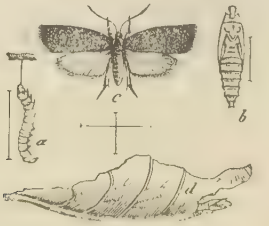


FIG. 3.

FIG. 4.

FIG. 6.

FIG. 5.

FIG. 1.

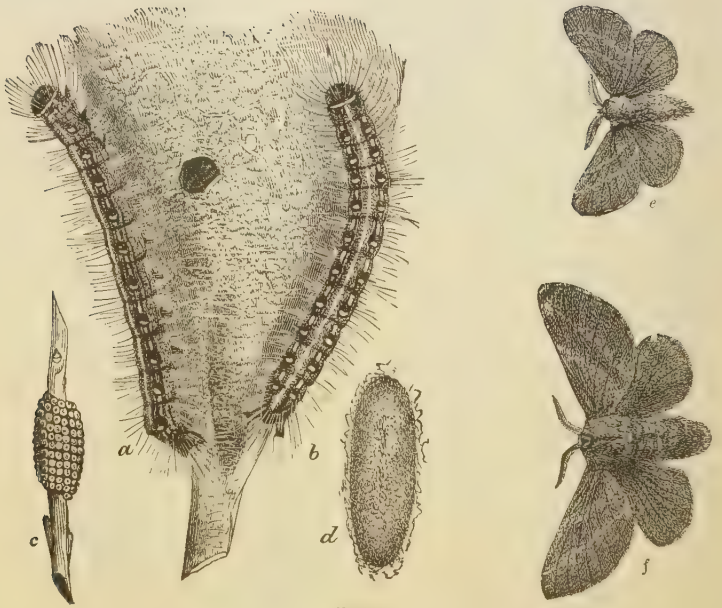


FIG. 2.

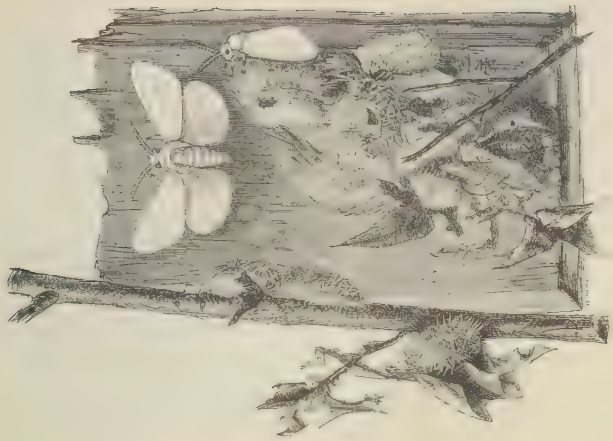


FIG. 1.

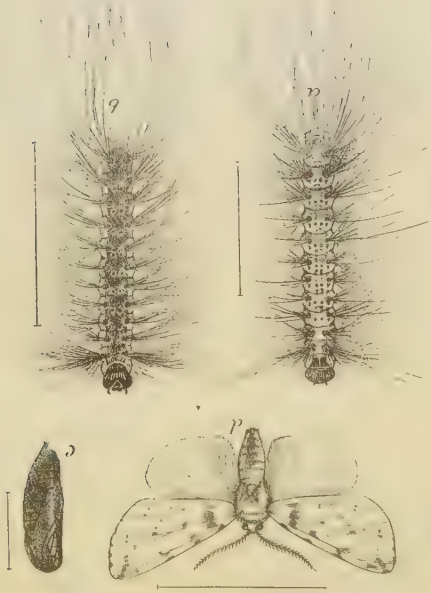


FIG. 2.

FIG. 1.

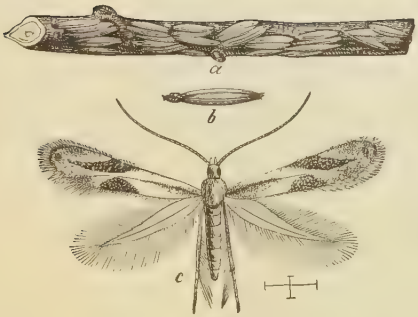


FIG. 2.

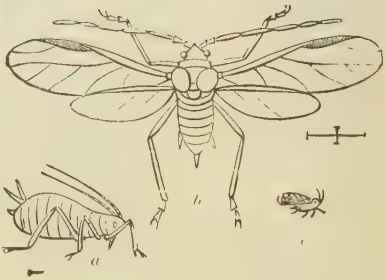


FIG. 3.

FIG. 4.

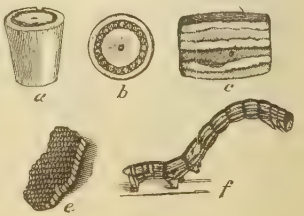


FIG. 5.

FIG. 1.

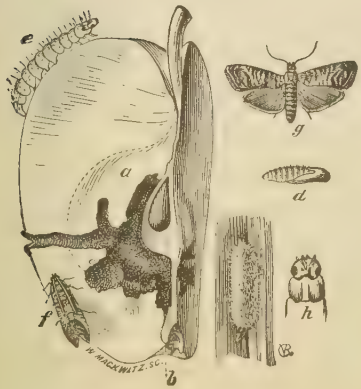


FIG. 2.

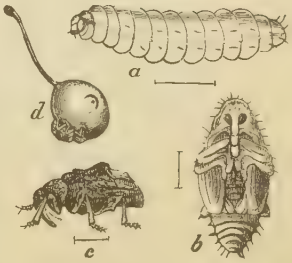


FIG. 3.

FIG. 1.

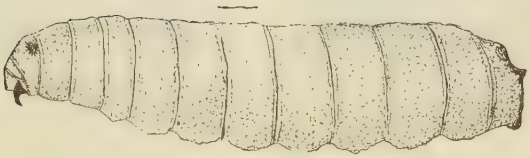


FIG. 2.

FIG. 3.

It is particularly bad in Maine, attacking nearly all varieties of apples, both fall and winter, though most destructive to the early sweet varieties. It is known as the railroad worm in Maine.

Description.

Eggs.—Length .038 to .036 inch; breadth .008 to .009 inch; light yellow when taken from the fruit; fusiform and about four times as long as wide; pedicellate at the end. The larva is placed in the egg with the head away from the pedicel and the end containing the head is inserted into the apple.

Larva.—Length .28 to .32 inch; breadth .07 to .08 inch. When full grown usually yellowish white. When younger, and sometimes when full grown, tinged with greenish; footless; the body composed of fourteen segments. Ninth, tenth and eleventh segments widest, narrowing rapidly toward the head, which is small, pointed and emarginate. From the broadest segment the body slopes slowly backward to the last segment, which maintains its size one-third of its length and then abruptly slopes to one-half its thickness. The lower and posterior half is nearly vertical behind, giving the larva a docked appearance.

Pupa.—Length .17 to .21 inch; breadth .08 to .1 inch; pale yellowish brown. When the maggot assumes the pupa state it does not shed the larval skin, but contracts, assuming an oval form. The pupa is a little more than twice as long as wide, and barrel-shaped. The ends slope about equally, and the head end is very pointed. Otherwise the resemblance between the pupa and larva is apparent. There is quite a variation in the size of pupæ. Some are much longer and thicker than others and may be of females, as the female flies are much larger than the males.

Perfect Insect.—A two-winged fly somewhat smaller than the house fly. Readily recognized by its general black color; yellowish head and legs; dark feet; greenish prominent eyes; white spot on the back and upper part of the thorax; three white bands across the abdomen of the male, four on the female, and four black bands across the wings, resembling the outlines of a turkey.

Life History.

In early seasons, under favorable conditions, the flies in Maine begin to emerge about July first, and earlier in the states farther south. They continue to emerge all summer and are on the wing in abundance until the middle or last of September, and occasionally in October. Early frosts check them. The flies lived three weeks in confinement and will probably live longer in nature. They begin to deposit their eggs in the early fruit by July first, or earlier, and egg laying continues while the flies are on the wing. The earlier races of flies affect the earlier

varieties, and the later races, the fall and winter fruit. Each female is capable of laying between three and four hundred eggs, and possibly more, which are inserted from time to time, one in a place, by means of a sharp ovipositor through the skin of the apple. The eggs being successively developed in the ovary of the female, after the manner of the eggs of the barnyard fowl, the season of egg laying extends over considerable time. The eggs are vertically inserted into the pulp of the apple, with the end opposite the pedicel, which contains the head of the maggot, pointing toward the core. The eggs are deposited in all parts of the apple, usually upon the cheeks, sparingly near the calyx and stem ends, and more abundantly upon the pale or shaded side of the fruit. The time required to deposit the eggs is about one-half minute. By means of the sharp ovipositor a characteristic puncture is made through the skin of the apple. These punctures can be detected by careful observation with the naked eye, but a pocket lens is necessary to see them well. They appear as brownish specks, and have not been before distinguished from the brownish, rusty spots common on apples. Under the glass they appear as circular or oblong openings, surrounded by a brownish border, somewhat shrunken by the shriveling of the tissue beneath. They may be numerous on the same apple.

The eggs hatch in four or five days, under favorable conditions, and the minute larvæ begin at once to work in the pulp of the apple. They have no true opposable jaws, but the head is provided with two black curved hooks, situated above the mouth, with which they rasp the pulp of the fruit rapidly by means of a vertical movement of the head. They live upon the juice of the particles of apple thus detached, which is sucked into the mouth. The pulp is rejected and turns brown. They can burrow their length in soft fruit in less than a minute. The channels made by the young larvæ, while the fruit is still growing, are largely healed and neither they nor the minute white larvæ are likely to be detected by the naked eye, or by the casual observer. As the larvæ grow, and the fruit matures, the enlarged channels do not heal, but turn brown and the presence of the maggots is then readily detected. These channels meander through the whole fruit, even the core. They often cross each other, enlarge as the larvæ grow, and in the last

stages of Trypeta work, run together, producing large cavities. Finally they involve the whole fruit, rendering it a worthless mass of disgusting corruption, held together by the skin.

In the early stages of Trypeta work there is no external evidence that the fruit is infested, excepting the punctures made for the insertion of the eggs. In advanced Trypeta work, brownish trails, where the larvæ have come to the surface, can be seen through the skin. Apples marketed with no suspicion of their being infested are frequently found hopelessly involved, honeycombed and worthless. Apples apparently sound when gathered may, by the presence of eggs or young larvæ, afterwards become worthless. The newly hatched larvæ are a little shorter than the egg and can not readily be detected in the white pulp of the apple without a pocket lens. They attain their growth, under favorable circumstances, in four or five weeks, but their development may be arrested by cold, by insufficient food, hardness of the fruit, etc., for a great length of time. They ordinarily remain in the fruit but a short time after they mature, and often leave it and go into the pupa state while there is still an abundance of nourishment and the fruit is still occupied by younger larvæ of various ages. If the fruit is kept cold, the larvæ, though full grown, remain longer, or may even change to the pupa state, within it. We have never seen the exit holes in hanging fruit and believe the maggots do not drop, but go into the ground from the fallen fruit. Their presence causes the fruit to mature earlier. Fruit picked from the trees may contain larvæ, and often stored or marketed fruit is alive with maggots.

The exit openings are characteristic, irregular holes, about one-twelfth inch in diameter, surrounded by a brownish border. They look as though the maggots had gnawed a hole for the head, and then forced the body through, leaving a lacerated border. They may occur anywhere on the apple but are more frequently found where the brown larval trails show through the skin. They begin to appear in the early apples about the first of August and may be found until frost, in windfalls, and in the stored fruit as long as the larvæ remain.

It would seem that the development of the larvæ is so nicely timed that they are not mature until the fruit is ripe. Their

development is slower in late and in hard fruits. A dozen maggots may infest the same apple, though a single one is enough to render it worthless. The maggots have been found in numerous varieties, early and late; sweet, acid, and sub-acid, extending from early in July through August, September, October, November, December, January and February. The larvæ usually leave the apples and go into the ground an inch or less and soon change to the pupa state. The pupæ are occasionally found within the fruit in windfalls and quite frequently in stored fruit. Sometimes the larvæ change on the surface of the ground, under decaying fruit. On grass ground they probably change in the debris about grass roots.

Remedies.

The Trypeta is an unusually hard insect to destroy, since the eggs are laid under the skin of apples; the larvæ spend their time within the fruit; the pupæ are safely concealed in the ground, within the shrunken skins of the larvæ; thus in all forms it is immune from the attacks of parasites. The flies do not seem to be attracted by sweetened poisonous substances and cannot be trapped. The eggs are so safely lodged underneath the skin of the apple as to be beyond the reach of poison applied by spraying, hence there is no hope in that direction. The only chance left is to destroy the larvæ and pupæ. This can best be done by destroying the fruit within which they are contained. The larvæ are found abundantly in windfalls and in decayed fruit from the cellars, and the pupæ in bins and barrels where fruit has been stored. Destroying the windfalls, and all refuse fruit, and burning the rubbish from places where fruit is stored are, then, the only reasonable and practicable methods of treatment now recognized.

DESCRIPTION OF PLATES.

PLATE I. Beneficial Insects. See p. 107.

Fig 1.—*Pimpla inquisitor*, an ichneumon parasite of the tussock moth caterpillar. *a*, parasitized caterpillar; *b*, egg of parasite; *c*, same in situ; *d*, parasite larvæ issuing; *e*, parasite cocoons—all slightly enlarged, except *b* and *c*, which are much enlarged. (After Howard. Farmer's Bulletin 99, U. S. Dept. Agr.)

Figs. 2 and 3.—Ichneumons, parasitic upon apple tree tent caterpillar.

Fig. 4.—Ichneumon parasitic upon flat-headed apple tree borer.

Fig. 5.—The 15-spotted lady bird, destructive to plant lice. *a*, larva; *b*, chrysalis; *d*, *e*, *f*, *g*, various forms of the perfect insect.

Fig. 6.—The twice-stabbed lady bird, destructive to the oyster-shell bark louse.

Fig. 7.—Tachina fly, parasitic on apple tree tent caterpillar.

PLATE II.

Fig. 1.—Round-headed borer (*Saperda candida*). See page 108. *a*, larva; *b*, pupa; *c*, beetle.

Fig. 2.—Flat-headed borer (*Chrysobothris femorata*). See page 109. *a*, larva; *b*, pupa; *c*, head of larva, under side; *d*, beetle.

Fig. 3.—Woolly louse. (*Schizoneura lanigera*). See page 113. *a*, excrescence upon the root; *b*, the lice at work; *c*, a louse much magnified.

Fig. 4—Pear-blight beetle or shot-borer (*Xyleborus pyri*). See page 112.

Fig. 5.—Work of the pear-blight beetle.

(Figs 4 and 5 after Howard).

PLATE III.

Fig. 1.—Oyster-shell bark louse (*Mytilaspis pomorum*). See page 110. *a*, egg; *b*, female louse; *c*, *d*, *e*, *f*, stages in the life history; *g*, under side of female scale,—all much magnified.

Fig. 2.—Oyster-shell bark louse. Scales in place upon the bark.

Fig. 3.—Lesser apple leaf folder, (*Teras minuta*). See page 117. *a*, larva; *b*, pupa; *c*, moth; *d*, case made on apple leaf. (After Smith).

Figs 4 and 5.—Oblique-banded leaf roller (*Cacœcia rosana*). See page 116.

Fig. 6.—Bud moth (*Tmetocera ocellana*). See page 114. (Cornell Expt. Sta., Bulletin 50).

PLATE IV.

Fig 1.—Forest tent caterpillar (*Clisiocampa disstria*). See page 118. *a*, egg clusters; *b*, moth; *c* and *d*, eggs; *e*, caterpillar.

Fig. 2.—Apple tree tent caterpillar (*Clisiocampa Americana*). See page 120. *a* and *b*, larvæ; *c*, egg cluster; *d*, pupa; *e*, male moth; *f*, female moth.

PLATE V.

Fig. 1.—Fall web worm (*Hyphantria cunea*). See page 121. Moths and cocoons—natural size. (After Howard. Farmer's Bulletin 99, U. S. Dept. Agr.)

Fig. 2.—Fall web worm. *a*, light form of full-grown larva; *b*, dark form of same; *c*, pupa; *d*, spotted form of moth (compare fig. 1), all slightly enlarged. (After Howard. Farmer's Bulletin 99, U. S. Dept. Agr.)

PLATE VI.

Fig. 1.—Lime tree winter moth (*Hybernia tillaria*). See page 123. *a*, larvæ at work; *b*, female moth; *c*, male moth.

Fig. 2.—Apple leaf bucculatrix (*Bucculatrix Pomifoliella*). See page 125. *a*, cocoons, natural size; *b*, same, enlarged; *c*, moth, enlarged.

Fig. 3.—Apple tree aphis (*Aphis mali*). See page 129. *a*, female; *b*, male; *c*, male, natural size.

Fig. 4.—Fall canker worm (*Anisopteryx pometaria*). See page 128. *a*, male moth; *b*, female moth; *d*, egg cluster.

Fig. 5.—Fall canker worm,—eggs and larva. *a* and *b*, egg, enlarged; *c*, segment of larva enlarged; *e*, egg cluster; *f*, full grown larva.

PLATE VII.

Fig. 1.—White-marked tussock moth (*Orgyia leucostigma*). See page 126. *a*, larva; *b*, female pupa; *c*, male pupa; *d*, *e*, male moth; *f*, female moth; *g*, same, ovipositing; *h*, egg mass; *i*, male cocoons; *k*, female cocoons, with moths carrying eggs—all slightly enlarged. (After Howard. Farmer's Bulletin 99, U. S. Dept. Agr.)

Fig. 2.—Codling moth (*Carpocapsa pomonella*). See page 133. *a*, fruit showing work of larva; *b*, point of entrance; *c*, larva, full grown; *d*, pupa; *f*, *g*, moth; *h*, head of larva; *i*, cocoon. (After Riley).

Fig. 3.—Plum curculio (*Conotrachelus nenuphar*). See page 134. *a*, larva; *b*, chrysalis; *c*, beetle; *d*, beetle and its work—all except *d*, enlarged.

PLATE VIII.

Fig. 1.—Apple maggot (*Trypeta pomonella*). See page 136. Mature fly (female), much enlarged.

Fig. 2.—Apple maggot. Larva much enlarged.—The short line above shows the natural size.

Fig. 3.—Apple maggot. An infested fruit.

INDEX TO BULLETIN 56.

	PAGE
Anisopteryx pometaria	128
Aphis, apple tree	129
Aphis mali	129
Apple maggot	136
Apple tree tent caterpillar	120
Bark louse, oyster-shell	110
Beneficial insects	107
Borer, flat-headed	100
Borer, round-headed	108
Bucculatrix, apple leaf	125
Bucculatrix Pomifoliella	125
Bud moth	114
Cacœcia rosana	116
Canker worm, fall	128
Carpocapsa pomonella	133
Cecropia emperor moth	132
Chrysobothris femorata	109
Clisiocampa Americana	120
Clisiocampa disstria	118
Codling moth	133
Conotrachelus nenuphar	134
Curculio, plum	134
Emperor moth	132
Fall canker worm	128
Fall web worm	121
Flat-headed borer	109
Forest tent caterpillar	118
Hyphantria cunea	121
Hybernia tillaria	123
Ichneumon flies	107
Insects affecting foliage	114
Insects affecting fruit	133
Insects affecting trunk and branches	108
Lady birds	107
Leaf folder, lesser	117
Leaf roller, oblique-banded	116
Lesser apple leaf folder	117

PAGE

Lime tree winter moth 123
Mytilaspis pomorum 110
Oblique-banded leaf roller 116
Œdemasia concinna 130
Orgyia cucostigma 126
Oyster-shell bark louse 110
Pear-blight beetle 112
Platysamia cecropia 132
Plum curculio 134
Railroad worm 136
Red-humped apple tree caterpillar 130
Round-headed borer 108
Saperda candida 108
Schizoneura lanigera 113
Shot-borer 112
Syrphus flies 107
Tachina flies 107
Tent caterpillar, apple tree 120
Tent caterpillar, forest 118
Teras minuta 117
Tmetocera ocellana 114
Trypeta pomonella 136
Tussock moth, white-marked 126
Web worm, fall 121
White-marked tussock moth 126
Woolly louse 113
Xyleborus pyri 112

[The papers which follow were prepared by Professor Harvey in the fall of 1899 before his illness, and were in press at the time of his death. C. D. W.]

NOTES ON INSECTS OF THE YEAR 1899.*

F. L. Harvey.

The year has been somewhat remarkable on account of the great abundance of several species of plant lice, leaf rollers and bud moths, and the great number of forest tent caterpillars. The important species of the year are considered below in notes or in greater length under special titles. The less important forms are merely mentioned in the table of insects (page 40) examined in 1899.

Chinch bug. (*Blissus leucopterus*). The chinch bug is reported as being quite abundant on the farms of Mr. Chas. Evans and Mr. W. L. Howe and others in the intervale lands near Fryeburg. It attacks herdsgrass, eating the bulbous bases of the stems after haying, requiring reseeding. Figured on page 111 of Report of this Station for 1894.

Destructive pea louse. (*Nectarophora destructor,* Johnson). This new species of pea aphis was very abundant in Maine the past season, doing much damage to garden and field peas.

Cucumber plant lice. Plant lice were very abundant on squashes and cucumbers the past season, doing much damage. The common species, *Aphis gossypii,* was responsible for most of the injury, though another species common on rough amaranthus was also found on squashes.

The corn louse, (*Aphis maidis*), was abundant on sweet corn in some parts of the State.

Dobson fly. Helgramite. (*Corydalis cornuta*). The nymphs as well as the flies of this species have been received several times for examination, indicating that the species is abundant in Maine waters. The nymph is the well known bass bait. The nymphs and flies are both large and attract attention. The former is the terror of smaller water insects, while the latter is conspicuous by its large head, powerful jaws, and long coarsely nerved wings.

* Paper from the [illegible] Entomological [illegible]

THE LESSER LEAF ROLLER. (*Teras minuta*). The specimens examined were bred from apple foliage. It also attacks cranberries and huckleberries and is one of the fire worms of cranberry bogs. It is considered in detail in Bulletin 56 of this Station.

THE OBLIQUE-BANDED LEAF ROLLER. (*Cacœcia rosana*). This was bred from the foliage of apple trees sent by Mr. Chas. S. Pope, Manchester. It is a new apple insect in Maine, at least we have not seen it before on apples. We reared the moths from currant leaves in 1894.

AMERICAN ELM PLANT LOUSE. (*Schizoneura americana*). This insect was abundant about Orono, Bangor and Augusta.

Work of the elm plant louse.

Work of the eye-spotted bud moth.

EYE-SPOTTED BUD MOTH. (*Tmetocera ocellana*). The moth was bred abundantly from apple twigs. It has done much damage to the flower and leaf buds and foliage of apple trees the past season. It is considered in detail in Bulletin 56 of this Station.

CHERRY TREE UGLY-NEST. (*Cacœcia cerasivorana*). This is a new apple insect for Maine. It was reported, also, as feeding upon choke cherry, its more common food plant, and upon

hazelnut. The conspicuous nests are common on choke cherry bushes in Maine, but uncommon on apples.

APPLE BUCCULATRIX. (*Bucculatrix pomifoliella*). The cocoons of this insect were received from Mr. L. F. Abbott of the Lewiston Journal, who reports them abundant in Lewiston. He also reports having seen them at Wilton, Jay and Livermore. For detailed account see Bulletin 56 of this Station.

THE AMERICAN TIGER MOTH. (*Arctia americana*). This was found on beets in a garden. It is not a common species in Maine. The fore wings are brown with white bands, the hind wings orange with round black spots. The moth has nearly three inches spread of wing. The beet belongs to the same family as the pigweeds (*Amaranthus*) upon which some tiger moths feed.

SPHINX MOTHS were quite abundant the past season. The elm sphinx was abundant on elms; the grape sphinx (*Philampelus achemon*) reported on grapes; the twin-spotted sphinx on apple. These insects are not usually abundant but the larvæ are capable of doing much damage on account of their large size and voracity.

THE STALK BORER. (*Gortyna nitela*). Specimens of strawberries containing the half grown larvæ of the above species were received from Buxton. The caterpillars were entirely buried in the berries. This habit is not new to entomologists, but so far as we know has never been observed before in this State. It has been detected boring into potato vines in Maine.

The usual number of specimens of *Cecropia, Promethea* and *Polyphemus* moths were reported. All were found in the cocoon or larval form upon apple trees. Cecropia was also reported feeding on plums.

THE VELLEDA LAPPET MOTH, though not an abundant insect in Maine, continues to be reported as doing some injury to plums. The books give the apple, poplar and other plants as its most common food. It is called the lappet moth because the caterpillar has a flat lobe or lappet on the sides of each segment. These lobes are provided with long hairs, giving the caterpillar a fringed appearance. When at rest the larvæ lie close to the branches and are hard to find.

THE FOREST TENT CATERPILLAR was very troublesome the past season in southern and western Maine. Many articles

appeared in the papers of the State regarding them. The Station issued a newspaper bulletin on the insect and the writer prepared an article for a bulletin issued by the State Board of Agriculture. It will be impossible to treat this insect in the forests, but an effort ought to be made to prevent its ravages upon ornamental and orchard trees.

THE FALL CANKER WORM, though reported from the center of the State, did not do great damage the past season and has become scarce about Orono.

THE MONARCH BUTTERFLY. (*Anosia plexippus*). This was unusually abundant the past season in the center of the State. The pale green chrysalids with golden spots on them are very beautiful objects and sure to attract attention. This large brown butterfly has black-veined wings on the black borders of which are many white spots. The larvæ feed on the milkweed. It is believed that the species dies out each season in the northern states and that the butterflies migrate from the south each spring. We have seen masses of this species as big as a bushel basket clinging together on the branches of a tree.

THE MOURNING CLOAK BUTTERFLY was exceedingly abundant the past season. It is a very bad elm tree insect, doing much damage to the shade trees in villages and cities. It is described in Experiment Station Report, 1888, p. 187.

THE DRONE FLY. (*Eristalis tenax*). This species was reported as being found about bee hives. These flies feed upon pollen and honey. They may have been attracted to the hives by the odor of the honey, but they would not venture into the hive and could do no harm.

ANTHOMYIID FLIES, probably *Pegomyia vicina*, were reported as doing much damage to the beet leaves in gardens. The larvæ of these flies work between the upper and under surface of the leaves, eating the leaf pulp and leaving whitish trails, not only injuring their functions but rendering them unsuitable for greens.

THE CURRANT FRUIT FLY. (*Epochra canadensis*). This species which has done so much injury about Orono was reported from Augusta, the past season. It attacks the fruit of the currant, causing it to turn red early, and drop prematurely. See Experiment Station Report, 1895, p. 111.

THE BUFFALO CARPET BEETLE has been reported the past season from seven localities, representing every section of the State. For a consideration of this insect see Experiment Station Report, 1894, p. 115.

THE STRIPED SAP BEETLE. (*Ips fasciatus*). The last of June the following letter accompanied by specimens was received from Mrs. J. K. Garland, Eden, Maine: "I send you an insect that is killing my locust trees. It works on the trunk of the tree boring under the bark. In ten days it has apparently killed one tree and is attacking others. Is there anything that will destroy them? Will they be likely to attack maples and elms?"

The specimens received were the above species, an insect that has never been accused of more serious depredations than sucking the exuding sap from wounds on trees produced by mechanical injury, or insect depredations. Although we did not see the trees we feel sure they were suffering from attacks of borers and the sap beetles were there to feed upon the sap exuding from the borings.

THE MAY BEETLE continues to do damage in grass lands. The large white grubs of this species are the larvæ of the well known June bug. They feed upon the roots of grass and other plants, often doing great damage.

THE CHERRY LEAF BEETLE. (*Adimonia cavicollis*). This beetle was reported as doing much damage to the foliage of cherry trees. The species is common about Orono. It is reddish brown in color and about three-sixteenths of an inch long.

BEAN WEEVILS were reported as feeding upon stored beans. This pest seems to be widely distributed in Maine.

LARRID BEES. Last September we received a box of specimens from Mr. F. A. Campbell of Cherryfield and the next day specimens of the same insect from Mr. B. F. Grace of West Harrington. Mr. Campbell says his specimens "were dug from a gravelly, loamy hillock in a pasture. They have been known in the locality for three years. Over an area of 100 feet by 30 feet the ground is completely perforated with small holes the size of a pea and with a little earth around the entrance. In the middle of the day when it is sunny it is said they swarm over the hillock in great numbers making a noise with their wings that can be heard several hundred feet in the woods which surround the hillock. They are supposed to be Italian bees by some, but

if so, their habits are different from what I supposed. Some would like to dig for a ton of honey, but we shall not have them disturbed until we hear from you." Mr. Grace confirms the above account. The specimens sent were land bees and were accompanied by cells filled with *bee bread,* the pollen of plants, probably stored as food for the young bees. The larrids usually store their burrows with grasshoppers and related insects and are beneficial. The bee bread in this case had the smell of old cheese. There are fully fifty species of these sand bees in the United States and Canada, found mostly in the southwest. They do not make honey.

THE BROWN TAIL MOTH. (*Euproctis chrysorrhœa*).

F. L. Harvey.

Specimens of the brown tail moth were taken the past season on Cut's Island, Kittery Point, Maine, by Mr. Charles Elliott Thaxter. He thinks they were imported from Cambridge, Mass., in household goods and that they have been on the island for two years and are probably established. This insect was reported from South Berwick, Maine, in 1897, but we were in doubt as we did not see specimens. (See Experiment Station Reports, 1897, p. 175 and 1898, p. 126). Mr. Thaxter kindly sent us a specimen taken by him as stated above. This dangerous insect enemy of the pear and many other trees, herbs and shrubs has to be added to our long list of insect pests.

Distribution and History. The brown tail moth is a native of the eastern continent, occurring in Europe, Northern Africa and Asia Minor. In the United States it was first called to the attention of the Gypsy Moth Commission of Massachusetts in May, 1897, at Somerville, Mass. Investigation showed that it had been in that region for at least three years. How it was introduced is not known. The first knowledge the Experiment Station had of its appearance in Maine was the following letter from Mr. Sessions of the Gipsy Moth Commission of Massachusetts:

"We are now making an inspection of the territory infested with our new imported pest, the brown tail moth (*Euproctis chryssorrhœa*). Our inspector in discharge of his duty called on Dr. Geo. E. Osgood of No. 283 Highland Avenue, Somerville.

The doctor is one of the reliable physicians of Somerville. His place is infested with the moth. He said that he saw the brown tail moth in South Berwick, Maine, while on his last summer's vacation, and was sure that it was identical with the Somerville pest. He also said that while he was in South Berwick he professionally treated two cases of poisoning by contact with the moth and that the symptoms of the patients were identical with those of his Somerville patients who had been poisoned by the brown tail moth. The premises in South Berwick are owned by the doctor's father-in-law, Andrew Whitehouse, 10 Goodwin St., South Berwick. I send you notice that you may take such measures as you think proper in the case."

We have no doubt but what Dr. Osgood's observations were correct, although we were not able to secure specimens at the time or since. Mr. Whitehouse wrote us in 1898 as follows: "I cannot find any specimens to send you. In the summer of 1897 my boy was badly poisoned by them. They were numerous on a woodbine on my premises and a few on my fruit trees. Last year I cut down the woodbine and burned it and have not seen any since." Mr. Whitehouse may have destroyed the colony, at least it is to be hoped that he did. He thinks they were imported on roses from Somerville, Mass.

Charles Elliott Thaxter writing under date of July 14, 1899, from Cut's Island, Kittery Point, Maine, says, "My father thinks that you would be interested to know that we have caught two brown tail moths this month, one on the wing July 3d, and another at rest July 12. My father thinks the cocoons or caterpillars must have been brought here from Cambridge two summers ago on our household goods, as brown tail moths were very plentiful about our house in Cambridge while we were packing. My father feels sure that they were not brought this year and thinks that they are likely to have become established on this island." We requested Mr. Thaxter to send us a Maine specimen of the moth and he did so. Food plants of the moth in Europe are the apple, pear, plum and rose of the rose family, and a number of forest trees. In this country it seems to prefer the pear but has been found feeding upon between thirty and forty herbs, shrubs or trees including many families, showing it to be a general feeder.

The following account of the life history of this insect is taken from a special bulletin issued July, 1897, by the Massachusetts Experiment Station.

DESCRIPTION.

"The eggs are laid in July, in masses of from 200 to 300, usually on the under side of the leaves, and are covered with the brown hairs from the end of the abdomen. They hatch in a short time and the young caterpillars feed during the rest of the season on the surface of the leaves, leaving in a few days only the skeleton. While still young they begin to make a regular dwelling in which they hibernate during the winter. This habitation is constructed at the ends of the twigs and is made by drawing together a few leaves, lining them with silk and surrounding them with a mass of silken threads. These tents are so firmly fastened to the twigs that they cannot be removed without using considerable force.

"Before the leaves begin to grow in the spring, the young caterpillars emerge from their winter retreat and often feed on the swelling buds. They reach their full growth in the early part of June and transform to pupæ. In a lot of about eighty, bred in confinement, the last one pupated June 18.

"The full grown caterpillars are from an inch and a quarter to an inch and three-quarters in length. The head is pale brown, mottled with dark brown, with reddish brown hairs scattered over the surface. The body is dark brown or black with numerous fine, dull orange or gray spots over the surface, most pronounced on the second, third and fourth segments. Long, reddish-brown, finely barbed hairs arise from all the tubercles, and white branching hairs arise from the upper side of the lateral tubercles on segments 4 to 12 inclusive. These white hairs form elongated white spots along each side and are one of the most striking characteristics of this caterpillar. The subdorsal and lateral tubercles on segments 4 to 12 inclusive are covered with fine short spines of uniform length. There is a vermillion red, retractile tubercle on the top of the tenth, and a similar one on the top of the eleventh segment.

"When the caterpillars are done feeding they change to pupæ among the leaves, two or more often transforming together, spinning an open cocoon of coarse silk. The pupæ are about three-fourths of an inch in length, dark brown in color, and with fine yellowish brown hairs scattered over the surface. In a short time the moths emerge from the cocoons and after mating lay their eggs.

"The males are pure white with a satin-like luster on the fore wings, a reddish brown tuft at the end of the abdomen and sometimes there are a few black dots on the fore-wings. The antennæ are white and fringed with pale yellowish hairs. They measure about an inch and a quarter between the tips of the expanded wings.

"The females are of the same color as the males, except that they have no black spots on the wings, the anal tuft is larger and lighter in color and the antennæ are shorter and have shorter fringes. Expanse of wings, about an inch and three-quarters."

HABITS OF THE CATERPILLARS.

The young caterpillars of the brown tail moth, after hibernating in the tents which they construct at the tip of the branches, emerge in the spring and feed downward towards the main branches and trunk, leaving the naked twigs bearing the gray tents at the ends, a conspicuous evidence of the presence of this insect. They eat the entire leaf except the midrib, and, in leaves having strong ribs, like those of the sycamore maple, all the larger ribs are left untouched. When the caterpillars are numerous they devour not only the buds, leaves and blossoms, but even the green fruit.

One of the most annoying features of this caterpillar is the painful irritation or nettling caused by the insects when coming in contact with the skin. The hairs of the caterpillar are brittle and easily become detached, and when they come in contact with the skin, produce a most intense irritation. From this cause many persons have suffered so severely as to require the aid of a physician. The invasion of houses by these insects is a common occurrence, and not unfrequently they make their way into the sleeping apartments

INSECTS EXAMINED IN 1899.

Common Name.	Technical Name.	Locality.	Remarks.
Bristle Tail	*Lepisma*	Riverside	About in cupboards.
Chinch Bug	*Blissus leucopterus*	Fryeburg	Quite bad in grass land.
Squash Bug	*Anasa tristis*	North Livermore	On squash and pumpkin vines.
Dog-day Harvest Fly	*Cicada tibicen*	Eliot	Taken on apple limb making incisions.
Pernicious Pea Aphis	*Nectarophora destructor*	Orono, Kennebunkport, Brunswick	On cultivated peas. Very abundant.
Cucumber Plant Louse	*Aphis gossypii*	West Eden, Belfast, Orono	On cucumbers.
American Elm Plant Louse	*Schizoneura americana*	Orono, Bangor, Augusta	Abundant on elms.
Dobson Fly. Helgramite	*Corydalis cornuta*	Auburn, Costigan	Common water insect used as bait for bass.
The Lesser Leaf Roller	*Teras minuta*	Manchester	Rolling foliage of apple trees.
The Oblique-banded Leaf Roller	*Cacœcia rosana*	Manchester	Attacking the foliage of apple trees.
Eye-spotted Bud Moth	*Tmetocera ocellana*	Manchester, Augusta	Destroying buds on apple trees.
Cherry Tree Ugly-nest	*Cacœcia cerasivorana*	Washburn	Feeding on apple, choke cherry and hazel nut.
Apple Bucculatrix	*Bucculatrix pomifoliella*	Lewiston	Specimens taken at Lewiston, Wilton, Livermore and Jay.
The Potato stalk Borer	*Gortyna nitela*	Buxton	Boring fruits of the strawberry.
American Tiger Moth	*Arctia americana*	Gardiner	On beets in garden.
Elm Sphinx	*Scritomia quadricornis*	Harmony, South Dover	On elms and on pinks in garden.
Hawk Moth. Sphinx Moth	*Philampelus achemon*	Gardiner, North Livermore	On grapes.

THE TWIN-SPOTTED SPHINX	*Smerinthus geminatus*	Orono	A common apple insect.
ROSY DRYOCAMPA	*Dryocampa rubicunda*	Foxcroft	On clover.
CECROPIA EMPEROR MOTH	*Samia cecropia*	Lagrange, Readfield, Kenduskeag	Plentiful on apples. One specimen on plum foliage.
PROMETHEA MOTH	*Callosamia promethea*	Machias	On apple trees.
POLYPHEMIS MOTH	*Telea polyphemus*	Stroudwater, Hampden	On apple trees.
BROWNTAIL MOTH	*Euproctis chrysorrhœa*	Kittery, Cuts Island	This dangerous moth has appeared in Maine.
VELLEDA LAPPET-MOTH	*Tolype velleda*	Troy	On plum.
FOREST TENT CATERPILLAR	*Clisiocampa disstria*	All sections of State	On shade trees in alarming numbers.
FALL CANKER WORM	*Alsophila pometaria*	Augusta	Larva on trees.
MONARCH BUTTERFLY	*Anosia plexippus*	Monmouth, Cornish, North Anson, Fairfield Centre	Received in the chrysalid stage mostly.
MOURNING CLOAK BUTTERFLY	*Euvanessa antiopa*	Augusta, Livermore Falls, Skowhegan	On elms.
DRONE FLY	*Eristalis tenax*	South Carthage	About bee hives. Not predaceous.
ANTHOMYIID FLY	*Pegomia vicina*	Union	Mining beet leaves.
THE CURRANT FRUIT-FLY	*Epochra canadensis*	Augusta	Infesting the fruit of currants.
CARPET BEETLE	*Anthrenus scrophulariæ*	All parts of the State	Attacking carpets.
THE STRIPED SAP-BEETLE	*Ips fasciatus*	Eden	On locust trees sucking sap which exuded from wounds made by borers.
MAY BEETLE	*Lachnosterna fusca*	Cherryfield, Walpole	In pastures.
THE CHERRY LEAF BEETLE	*Adimonia cavicollis*	Lewiston	Working on foliage of cherries.
BEAN WEEVIL	*Bruchus obtectus*	York Corner, East Lebanon	Working in dried beans.
PIGEON TREMEX. PIGEON HORNTAIL	*Tremex columbæ*	Sabattus	Working on elm and other trees.
PELECINUS	*Pelecinus polyturator*	Winterport	A black ichneumon with a long slender pointed abdomen which is usually curved.
LARRID BEE	*Larra*	Harrington, West Harrington	Burrowing in the ground.

The caterpillars are quite gregarious up to the later stages of their growth, when they disperse to some extent; but when they occur only in moderate numbers, they retain their gregarious habits to a greater degree than when they are very abundant, since in this case the supply of food is soon exhausted and they are forced to migrate. When these caterpillars molt they gather in masses on the branches and cover themselves with a scanty mass of silk. When preparing to change to the pupal stage several of the caterpillars spin up in a common cocoon within the leaves at the tip of the branches. When numerous, they frequently pupate in masses under fences and clapboards, or on the trunks and larger branches of the trees.

The webs of the brown tail moth should not be confounded with those of the tent caterpillar or the fall web worm. They may be distinguished from those of the tent caterpillar by being placed at the tips of the branches, while the tent caterpillar constructs its tent in a fork of the limbs. This latter insect rarely, if ever, attacks the pear which is a favorite food plant of the brown tail moth. The fall web worm, while often found on pear trees, spins a large open web at the ends of the branches and feeds within this web. This insect does not appear until after the brown tail moth has ceased to do damage.

Precautions. This pest does a great amount of damage in Europe where laws are enacted to hold it in check. The Commonwealth of Massachusetts has enacted a law looking to its suppression in that state and made an appropriation and put the matter into the hands of the Gypsy Moth Commission. Now that it is probably locally established in Maine immediate action should be taken to prevent its spreading. A careful inspection should be made of the localities where it has been found.

NOTES ON PLANTS OF 1899.

F. L. Harvey.

The past season was dry and the conditions unfavorable for the growth and spread of fungi and only a few were reported. The apple scab and potato blight were not as bad as usual. This was due in part to the dry season and probably in part to the greater amount of spraying done. There was not the usual number of weeds sent for determination and no new weeds are known to have been introduced the past season. Specimens of the following plants, mostly sent for identification, were received in 1899.

Bladder champion. (*Silene vulgaris*). This plant seems to be increasing as a weed in cultivated fields.

Silvery cinquefoil. (*Potentilla argentea*). This is a common plant on rocky ledges in Maine and is spreading along roadsides in many places. It attracts attention on account of the silvery pubescence on the under side of the leaves.

Biennial evening primrose. (*Œnothera biennis*). This tall weed, with bright yellow four-petaled flowers, is one of the most common in the State. It seeds heavily and growing in waste places is able to maintain itself. Its tall woody stems covered with four-celled pods are a common sight in winter.

Golden alexanders. (*Thaspium trifoliatum aureum*). This is a native plant and not reported before as a weed in fields. It is a perennial plant, usually growing in the woods and probably will be easily subdued by cultivation.

Hobble-bush. (*Viburnum lantanoides*). This is a native shrub, with beautiful foliage and attractive flowers. It is worthy of cultivation.

Cultivated daisy. (*Bellis perennis*). Like many other cultivated plants this species escapes from cultivation and appears in fields. It has not proved a persistent or bad weed.

ORANGE HAWKWEED. (*Hieracium aurantiacum*). This weed has been almost entirely destroyed on the college grounds by turning the grass land where the weed was thick and harrowing frequently through the season. Scattering plants in the fields were pulled and burned and the ground where they grew salted.

CANADIAN HAWKWEED. (*Hieracium canadense*). This is a coarse, leafy-stemmed weed, growing fully four or five feet high on good soil and bearing at the top a corymb of yellow beads. It is native and though sometimes found in fields, it has not shown a tendency to spread like its relatives, the orange hawkweed and king-devil weed.

RAGGED KNAPWEED. (*Centaurea Jacea*). This fugitive from Europe is common in some pastures of Maine, in fields and waste places. The large heads and the fimbriated outer bracts make it a conspicuous plant, sure to attract attention.

THE SAND BUR, BEAKED NIGHT SHADE. (*Solanum rostratum*). The sand bur is reported as occurring in fields. This objectionable weed has been found several times in Maine, usually about where cars of western grain were unloaded. It is more of a roadside weed in the West. It will probably not maintain itself in cultivated fields in Maine.

THE RATTLE-GRASS. (*Rhinanthus Crista-Galli*). This is a bad weed in sandy lands along the coast. There is probably no way to get rid of it, but by careful culture. It seeds profusely.

REED GRASS. (*Phragmites Phragmites*). This grass was received from Kenduskeag. It is rare in Maine, growing in wet places, and so we record the locality. It is sure to attract attention on account of its high and beautiful plumes. It grows from five feet to fifteen feet high and bears a silvery plume from six inches to a foot in length.

THE GRASS THRIPS (*Anaphothrips striata*, Osborn.)

LEWIS R. CARY.

Although the grass thrips is of much and growing economic importance, not only in this State, but in nearly all New England, it has received but little attention in this country, either from the structural or economic standpoint. Only one publication bearing upon the economic importance has been found.*

In 1880 Prof. Herbert Osborn published the description of a species of thrips under the name of *Thrips striata*, which he said caused considerable damage to the grass crop in the eastern states.

In Prof. Comstock's Introduction to the Study of Insects, which appeared in 1882, a species of thrips is described under the name of *Limothrips poaphagus*. This was reported as doing great damage to the early maturing grasses, especially June grass, *Poa pratensis*. Specimens of both of these forms sent to the Bureau of Entomology of the Department of Agriculture for identification were referred to the genus *Anaphothrips*. The specific name *striata*, given by Prof. Osborn, was retained on account of priority.

Before the question of the scientific name of the insect had been finally settled, it was the common custom to speak of it as the "grass thrips," and that name is still commonly applied to it except in strictly scientific writings.

DESCRIPTION.

A large proportion of the mature insects are females. They vary in length from one millimeter to one and one-half millimeters and are of two forms, winged and wingless. Both forms are comparatively long and slender and taper toward each end from the region of the thorax.

---

* Fernald and Hinds. The Grass Thrips. Treatment for Thrips in Greenhouses. Bul. 67, May, 1900. Hatch Exp. Sta., Mass. Agr. College.

The winged forms are larger than the wingless ones, brown in color, and have two pairs of long slender wings, each of which is reduced to a narrow piece, having two or three short veins, and bearing on its edges two rows of fine hairs, fig. 6, hw and fw. The hairs are placed so that the upper row on each wing crosses the lower row at an acute angle and, when the wings are extended, the hairs on the posterior edge of the fore wing overlap those on the anterior edge of the hind wing. This gives practically the same resistance as if the wings were entire. When the wings are folded they lie along the dorsal wall of the abdomen, nearly its entire length, with the anterior above the posterior pair. Their extremities are bent so that the ends of the wings on each side of the body turn away from each other.

In the wingless forms the wings may be entirely wanting, or they may be represented by small protuberances, fig. 5, wp. This form is light pink in color, and is covered with a thin soft integument. The head is small and tapers toward its anterior end. It bears two small compound eyes and three ocelli. The antennæ are placed on the extreme anterior part of the head, very near to the median line. They are about .2 m m. in length, and each is made up of eight joints. The basal joint is short and stout. The next three joints are flask shaped, the anterior enlarged end of each surrounding the neck of the succeeding joint. The fifth joint is smaller than any of the preceding. The sixth, seventh and eighth joints are fused into one long piece, the sixth being much the longest of these three joints. At the anterior end of each joint, around the rim of the cup, there is a row of rather short stiff spines. There are also a variable number of spines scattered over the surfaces of the several joints.

The mouth is situated on the ventral side of the head and, on account of the arrangement of the mouth parts, is placed so far posteriorly that it opens at a point posterior to the junction of the head and prothorax, fig. 14, mp.

The prothorax, figs. 6 and 14, is short, a little wider than the head, and nearly square in outline as viewed from the dorsal side. The ventral is very much shorter than the dorsal surface, as the head extends farther posteriorly on the ventral than on the dorsal surface, (see fig. 14). It bears along its sides a number of spines, and a few very short spines are scattered over the dorsal surface.

The mesothorax, figs. 6 and 14, msth, is, in the adult, about twice as long as either of the other thoracic somites. In the larva and pupa it is not proportionately so long. It is shaped like a barrel, except that it is thinner dorsoventrally at its anterior end. In the winged form it bears the wings, and in the wingless forms it is either smooth or bears the rudimentary wings. In the former its dorsal surface is broken up into a number of plates which allow for the movement of the wings.

The metathorax, figs. 6 and 14, mtth, is narrow in front and broadens out behind to join the abdomen. On its dorsal surface it has the appearance of being an abdominal rather than a thoracic somite.

Each of the three thoracic somites bears a pair of legs that have the usual number of joints. All of the joints, except the coxa and tarsus, are flattened laterally, fig. 16. The tarsus has at its extremity, in place of the usual claws, a bladder shaped organ, fig. 16, at the sides of which there are two small rudimentary organs that many entomologists interpret as being tarsal claws. The bladder is supposed to represent modified pulvilli.

The anterior pair of legs are quite short and stout, and are attached near the anterior part of the somite. The second pair of legs are somewhat longer and are attached to the posterior part of their somite. The third pair of legs are much the longest and slimmest of the three pairs. They are attached to the anterior part of the somite.

The abdomen is made up of eight somites. It tapers gradually from before backward, the last somite being quite slender. The first five somites are nearly alike in shape. The sixth somite is wedge shaped with its broad end placed on the dorsal surface and its edge on the ventral surface, fig. 14.

The ovipositor is attached at the junction of the sixth and seventh abdominal somites and when not in use fits into a small groove on the ventral surfaces of the seventh and eighth somites. It is made up of four valves, fig. 14, ovp, which are united so as to leave a groove on the dorsal surface, down which the eggs pass at the time of oviposition. The three angles of the ovipositor are sharply serrate, so that it will hold, while being worked into the tissues of the plant.

The males of this species, fig. 3, are not very frequently found, and it is thought that the majority of the females lay partheno-

genetic eggs. The males are not as slender as the females, and they differ from them somewhat in the position and shape of parts. The eyes are placed more dorsally. The prothorax is large, and has a pair of large spines at its posterior angle on each side. The mesothorax is short, and as seen from the dorsal surface, is nearly round in outline. The small metathorax has its line of junction with the mesothorax semicircular, and its posterior outline straight. The abdomen is quite narrow in front and grows gradually wider posteriorly as far as the fourth somite. From this point it tapers gradually to the posterior end of the body. The last somite is modified to form the male copulatory apparatus. This somite bears two pairs of large, long spines.

LIFE HISTORY.

The adult insects pass the winter months in the dead vegetation at the bases of their host plants, very close to or on the ground, where they are protected by the debris. In the spring as soon as the weather has become sufficiently warm to start the grass, they come out from their winter quarters and begin to lay eggs in the tender leaves of the young grass. The eggs are deposited in the tissues of the blades near their upper surfaces. Fernald and Hind * determined by keeping insects in captivity that each female is capable of laying from fifty to sixty eggs. The first eggs laid hatch in from twelve to fifteen days. Later in the season the time required is materially reduced. In the hot dry periods of the summer they may hatch in a week.

When the larvæ are hatched they seek some sheltered place in which to pass the next stages of their development. At this period of their development they are most frequently found in the sheaths of the blades, especially those of the young stalks, near the ground. In the later stages they sometimes congregate in the upper sheaths of the stem, and then they cause the "silver top," which is the most conspicuous evidence of their work.

The larvae, especially in the later stages, are quite active, running about the leaves inside of the sheath or even on the head, among the flowers. The pupal stage is passed in some quiet place, as at the base of the sheath of some lower leaf. In this stage the insect takes no food and moves only very sluggishly.

* The Grass Thrips. Bul. 67, May, 1900. Hatch Exp. Sta., Mass. Agr. College.

In the early spring months a large proportion of the females produced are of the winged form. They fly about and infest new fields, so that in a very short time a large area may become badly infested with the insects. As the season advances the number of the winged forms becomes less, until in the latter part of the season, September or October, there are very few of the winged form, among all those produced.

LARVA.

The larva, fig. 1, resembles the adult in shape and color but is smaller. Compared with the adult, the head of the larva is small, the antennae short, and there is not as much difference in the size and shape of the thoracic somites. There are very few spines on the body, a tuft on each of the last two abdominal somites being the only conspicuous ones.

PUPA.

The pupa, fig. 2, (last larval stage) has a very distinctive appearance. It is encased in an external covering, probably the last moulting case, which disguises the form of the insect to a great extent. The head is about the same shape as in the larva. The antennæ are bent back so that they lie upon the dorsal surface of the head and prothorax, and their covering shows neither joints or spines. The prothorax is shaped like that of the adult. The mesothorax is long and bears on its dorsal surface a pair of wing cases, which in the pupæ of the winged forms extend posteriorly nearly the length of the abdomen. In the pupæ of the wingless forms the wing cases are very short.

MOUTH PARTS.

Fig. 4.

The mouth parts of the Thysanoptera differ very much from those of the other orders of insects. They have, in part, the characteristics of the biting insects, and in part, those of the sucking forms. If we accept the old interpretation, and consider the piercing setæ mandibles, the typical mouth parts are all represented and are not much fused.

The labrum is triangular in shape, but quite unsymmetrical. It is longer on the right than on the left side, the greater part of the attachment of the base of the labrum being on the right side of the median line of the head.

The parts which have been described by most American writers as mandibles are slender bristle-like spines, each of which has an enlargement at its upper end. They are situated inside of the mouth, and when in use extend through the oral aperture. Sections of the head clearly show, as has been mentioned by Garman,* that the upper broad end of these parts are joined to the maxillæ by a short round basal piece. There is a distinct joint between these two parts.

The maxillæ are elongated, triangular in shape, and placed so that they form the lateral borders of the mouth. Near their middle point there is a three-jointed palp.

The labrum is made up of two thickened portions which lie at the side of the mouth below the maxillæ, and a third ventral portion connecting the thickened parts. It bears on its lower third a pair of three-jointed palps. The palps bear spines on the distal end of each joint.

On the left side of the head there is a single unpaired organ, shaped somewhat like one of the piercing setæ, only it is stouter and has the upper portion much thicker. There is nothing on the right side of the head to correspond to this organ except, in some cases a small papilla.

Inasmuch as the piercing setæ are composed of two portions united by a joint, they are not homologous with the mandibles of other Hexopoda, which are in all cases composed of a single piece. They should rather be regarded as specialized lobes of the maxillæ.

The unpaired organ has been interpreted by some writers as an epipharynx which has been shifted to one side. Others consider it to be the left mandible, the right mandible being wanting or rudimentary.

Considering the modification of the parts, and the apparent deficiency of the right side of the head, it would seem that the latter is the most reasonable interpretation.

---

* Garman, H.—The assymetry of the Mouth-parts of the Thysanoptera, American Naturalist, Vol. XXX, July, 1896.

DIGESTIVE SYSTEM AND ACCESSORY GLANDS.

Fig. 7.

The alimentary canal is small and short. It is only about one and one-half times the length of the body.

The mouth is little more than a narrow tube through which the setæ project. At its upper end it widens out and joins the pharynx, which runs anteriorly for a short distance, then turns sharply back, and joins the œsophagus. The œsophagus is very narrow and has an exceedingly small lumen. It passes backward over the anterior end of the first thoracic ganglion, and runs back to the middle of the mesothorax, where it joins the mid-intestine.

The mid-intestine is the longest part of the canal. It is separated by three constrictions into four divisions. The first and second divisions of the mid-intestines are of about equal length and together they extend from the mesothorax to the fifth abdominal somite, where they join the third division. At this point there is a sharp turn and the third division runs anteriorly as far as the anterior part of the third abdominal somite. Here, again, there is another turn, and the fourth division runs posteriorly as far as the sixth abdominal somite, where it joins the hind-intestine. At this point the malpighian tubules enter the intestine.

The hind-intestine is small and somewhat convoluted. It shows no division into ileum and colon. At the posterior end it is enlarged to form the rectum.

The mouth and pharynx have a chitinous lining which is quite thick. The anterior part of the œsophagus also has a thin, flexible, chitinous lining. The outer walls of the œsophagus are very thin and delicate and have very few muscle fibers.

The walls of the mid-intestine are much thicker, and are composed of several layers. On the inside is the lining membrane, the cuticula. Just outside of this, with their apices projecting into the lumen of the intestine, is a layer of large pyramidal epithelial cells. These cells are imbedded in a basement membrane of connective tissue, outside of which there are two layers of muscle fibers, one circular and the other longitudinal. Outside of these there is a thin membranous covering.

The epithelial cells in the first two divisions of the mid-intestine are especially active as secreting cells. Part of them are filled with granules that are suspended in the protoplasm of the cell, and others are quite free from these granules. In the posterior divisions of the mid-intestine the epithelial cells are not so large or high, but the arrangement of tissues is the same.

In the hind-intestine the cuticula is very thick and the epithelial cells are small and rather flat. The three inner layers of the hind-intestine are thrown up into folds which are not very noticeable in the anterior part, but are larger in the posterior part. In the rectum the folds are very large and form the so-called rectal glands. On the outside, in the depressions between these ridges, there are six bands of longitudinal muscle fibers. The rectum is larger than the rest of the hind-intestine, and has thick muscular walls. The rectal glands probably have no function as glands but are thought to be of use in closing the intestine.

SALIVARY GLANDS.

The salivary glands, fig. 7, sg, are two in number. They are situated in the dorsal region of the anterior part of the mesothorax, just in front of the anterior end of the mid-intestine, and dorsal to the œsophagus. The glands are ovate in shape and at their anterior ends give rise to a pair of small ducts which soon unite to form a single median duct. This runs forward, just dorsal to the œsophagus, and opens into the mouth near the oral aperture. The glands are made up of a small number of large cells, which are imbedded in a basement membrane of connective tissue. The cells have large prominent nuclei, and may be seen in different stages of secretion. Some are filled with granules and others have the cell contents free from granules. The lumen of the gland is small and irregular.

The fluid secreted by these glands would seem, from the position of the opening of the duct, to have little digestive function, but rather to serve as a lubricant for the mouth parts.

EXCRETORY SYSTEM.

The excretory apparatus consists of four large malpighian tubules, fig. 7, mt, which open into the intestine at the junction of the mid- and hind-intestine and extend as far anteriorly as

the first abdominal somite. They lie in the abdomen without any definite arrangement, occupying the spaces between the other organs and are richly supplied with tracheæ.

Each tubule is composed of large cells with prominent nuclei, that are so placed that they give it a spiral appearance. A transverse section shows from five to seven cells around the lumen of the tubule.

MUSCULAR SYSTEM.

Fig. 8.

The muscular system corresponds in its general arrangement to the segmented structure of the body; that is, most of the muscles are arranged inter-segmentally. The typical arrangement is shown in any of the anterior abdominal somites. When a transverse section is taken across one of these somites, fig. 13, four longitudinal rows, each composed of five muscles, are seen. The four rows are placed so that there are two on the dorsal and two on the ventral side.

The ends of these muscles are attached by a sort of tendon to the infolding of the integument between each two somites. In the last abdominal somite the posterior ends of the longitudinal muscles are attached to ridges in the integument. These muscles are bellied so that they are thicker in the middle than at the ends, and each is nearly square in cross section. The longitudinal muscles of the abdomen are all arranged on this plan. By this arrangement one end of the muscles of two somites being attached at practically the same point, it is possible to bring the fulcrum for any movement of the abdomen to the joint between any two somites, the combined action of the muscles of the somites anterior to this point keeping the anterior part of the abdomen rigid. The abdomen may be bent in practically any direction by means of the longitudinal bands of muscles, which may be contracted individually or in combinations, throughout the length of the abdomen, or in any part of it.

Near the middle of each abdominal somite there is, on either side, a pair of muscles which run from the dorsal to the ventral surface, fig. 8, stm. These provide for a dorso-ventral contraction of the abdomen, which is of service in respiration.

In the sixth and seventh abdominal somites there is, in addition to the typical muscles already mentioned, a set of muscles

which have to do with the movements of the ovipositor. These muscles are eight in number, four on either side of the median line. They are attached at their ventral ends to the ovipositor, and run dorsally and somewhat laterally around the intestine to be attached to the dorsal wall of the abdomen. When these muscles are contracted they bring the ovipositor out from its position in the groove on the seventh and eighth abdominal somites, where it lies when not in use, to the position in which it is used in depositing eggs. In this position it is placed at an angle of about thity degrees with the abdomen.

In the thorax the segmental arrangement of the muscles is greatly modified. On the dorsal side there are two rows of longitudinal muscles like those of the abdomen. On the median dorsal line of the mesothorax four muscles are attached. One pair of these muscles runs anteriorly and laterally and is attached to the ventral wall of the prothorax just posterior to the anterior legs. The other pair passes posteriorly and laterally and is attached just posterior to the hind legs. The arrangement of these muscles is such that when they are viewed from the dorsal side they form a cross the four extremities of which are attached to the ventral surface.

Attached to the fold of the integument that lies between the abdomen and metathorax, with their posterior ends overlapping the ventral ends of the posterior pair just mentioned, is another pair of muscles. These converge as they run forward, and are attached to a prominence on the floor of the metathorax near its anterior end. Between the posterior ends of these two sets of muscles another pair of muscles is attached. These diverge as they run forward, and are attached at the bases of the third pair of legs. From this point they converge and at the anterior end of the somite they are attached to the fold of integument between the meta- and mesothorax. Another pair of muscles is attached to the floor of the metathorax; they diverge as they run forward and are attached at the bases of the legs in the mesothorax. From this point they converge and are attached together on the floor of the posterior part of the prothorax.

In the prothorax there is a pair of muscles that has the same arrangement as the muscles last described, being attached at their posterior ends to the fold of integument between the pro- and mesothorax and running forward to the head. These also are attached near the bases of the legs in their somite. Another

pair, attached by a single head in the posterior part of this somite, diverge as they run forward, and are attached to the integumental fold between the head and prothorax. In the anterior part of this somite there are, on each side, three muscles which are attached at their ventral ends to the thorax, and at their dorsal ends to the head. In the posterior part of the head there are six muscles that are attached at their dorsal ends to the thorax and at their ventral ends to the head. These two sets of muscles cross one another at their middle points. The muscles that have to do with the movements of the mouth parts are situated in the anterior part of the head, on its ventral wall. A part of these muscles run anteriorly and dorsally to be attached to the front part of the head. The remainder run dorsally to be attached to the dorsal wall of the head.

Each leg is supplied with four muscles. One of these muscles lies along the floor of the thorax, and is attached at one end to a median ridge of the integument, and at the other end to the fold between the coxa and trochanter. This muscle serves as the flexor of the coxa. The other thoracic muscles of each leg are really the three heads of one muscle, the extensor of the coxa. These muscles are attached to the integument on the dorsal walls of the thoracic somites and at the other end to the integumental fold between the coxa and trochanter. The muscles in the next two joints of the leg (trochanter and femur) are arranged in much the same way, one of them acting as a flexor and the others as extensor. They are attached intersegmentally. In the next joint (tibia) there are only two muscles, one flexor and one extensor. Both of these muscles are continued into the tarsus by tendons. The tarsus has no muscles of its own.

In the winged forms there are, in the thorax, the muscles for the movement of the wings. These consist of two series on each side, one of which elevates and the other depresses the wings. Each series is made up of several muscles. There are two elevators and four depressors. Of these there is in each series, a single muscle that is much larger than the others and that does the greater part of the work in flight. The others serve to keep the wings in their proper position. All of these muscles are attached at one end to the ventral wall of the thorax, and at the other to the wings. The elevators are attached inside, and the depressors outside of the point which serves as the fulcrum for the movements of the wings.

NERVOUS SYSTEM.

Figs. 7 and 9.

The central nervous system is concentrated. It consists of five ganglia (morphologically pairs of ganglia), and a single large median nerve cord which passes from the posterior end of the fifth ganglion to the posterior part of the abdomen.

The cerebral ganglion, fig. 7, cg, is large and flat. It is divided superficially into halves by a cleft which is deep in front but shallow on the dorsal and ventral surfaces. Each half of the ganglion is pointed at its anterior end. The optic tracts pass out from the ganglion just posterior to these prominences. There is a slight constriction where they join the ganglion. Just posterior to the optic tract, there is on either side, a prominent swelling, the antennal lobe, from the ventral sides of which the antennal nerves pass anteriorly to the base of the antennae. The posterior part of the ganglion is narrower and thinner than the anterior part and is continued posteriorly over the anterior end of the first ventral ganglion and the œsophagus.

The surface of the first ventral ganglion clearly indicates that it is formed by the fusion of two ganglia, the infraœsophageal and the first thoracic. A well marked constriction separates the two. The nerves which supply the mouth parts are all given off from the anterior part of the ganglion. The nerves to the first pair of legs, as well as those of the muscles and other organs of the prothorax are given off from the posterior part of the ganglion. The nerves which go to the legs are very large, and pass from the side of the ganglion, obliquely to the bases of the legs.

The second thoracic ganglion is connected with the first by a broad commissure. It is much smaller than the first, nearly circular in outline and lies in the anterior part of the mesothorax. The nerves which go to the middle legs are given off from its posterior part. These nerves come from the under side of the ganglion and run obliquely backward to the bases of the legs.

The third thoracic ganglion is small, nearly round in outline, and is connected with the second by a very short broad commissure. It lies in the extreme posterior part of the mesothorax, and sends a large nerve obliquely backward to each of the legs that are attached to the metathorax.

The fourth ganglion is the largest of any in the ventral chain, and compared with them it is long and narrow. It lies partly in the metathorax and partly in the abdomen, and is connected with the third thoracic ganglion by a long slender commissure. It gives off nerves to the organs of the somites which it occupies, and is connected with the somites lying posterior to it, by the long nerve cord passing from its posterior end.

The cord which passes from the fourth ventral ganglion, runs posteriorly to the sixth abdominal somite, where it breaks up into a number of nerve fibers. These supply the reproductive organs, the special muscles of the reproductive organs, and the other organs and muscles in the last two somites of the abdomen.

All of the ganglia correspond very closely in their minute structure. Each ganglion is enclosed in two delicate membranes. Beneath these membranes there is a layer, of varying thickness, made up of large nerve cells, which stain deeply. This layer of nerve cells is thickest at a point a little way from either end. Between these thickened portions the layer of nerve cells is much thinner, and it is entirely wanting where the ganglion narrows down to form the commissure. The nerve cells are pear shaped and a single nerve fiber passes from the smaller end of each cell.

The central part of the ganglion is made up of fibers that run, for the most part longitudinally, except where some large nerve is given off. The commissures are composed entirely of nerve fibers, together with the two envelopes that surround them. The cord which passes from the fourth ventral ganglion is composed entirely of nerve fibers.

EYES.

The compound eyes, fig. 14, ei. are comparatively small, (about .06 mm. in diameter), placed on the sides of the head just back of the antennæ, and nearly circular in outline. Each eye is made up of from one hundred to one hundred and twenty facets. The facets in the two eyes of an individual may differ in number from ten to fifteen. Each facet is irregular in outline, but approximately circular and is strongly convex on the surface, so that the exterior of the eye has a roughened appearance. The facets near the center of the eye are larger than those near the outside. Those at the center are seven microns in

diameter, while those at the outside range from five to six microns in diameter.

The eyes are deeply colored with a dark brown pigment, which makes them very conspicuous. The ocelli, three in number, are placed between the compound eyes on the dorsal surface of the head, and are arranged in the form of a triangle. The anterior median ocellus is about seven microns in diameter and each posterior ocellus is about ten microns in diameter. They are not very conspicuous, as they have little pigment and are not raised much above the surrounding parts.

REPRODUCTIVE SYSTEM.

Fig. 7.

The reproductive apparatus of the female insect consists of two ovaries, each of which is made up of five ovarian tubes. Each ovarian tube is divided into three sections. First; the terminal thread, at the anterior end, by which that end of the ovary is attached to the dorsal wall of the abdomen. These threads all run together to form a single thread on each side. Second; the terminal chamber, which contains undifferentiated cell elements which give rise to the eggs. Third; the actual ovarian tubes, the chambered part of which contains the eggs.

The ovarian tubes are long and slender and extend from the fifth to the first abdominal somite. They contain no chambers of nutritive matter. At the posterior end of the ovaries there is, on each side, a very short oviduct, which soon unites with its fellow to form the common oviduct, fig. 7, ovd. This extends from the fifth to the junction between the sixth and seventh abdominal somites, where it opens to the exterior at the base of the ovipositor. There is no well marked receptaculum seminalis or accessory sac. The walls of the ovaries are thin, and are made up mostly of connective tissue. The walls of the oviduct are much thicker and well supplied with muscle fibers.

The largest eggs in the lower chambers are about .15 mm. in length and .06 mm. in thickness. They are deeply concave on the surface that is turned toward the median line of the body, and are covered with a strong membrane.

CIRCULATORY SYSTEM.

The circulatory system consists of a contractile dorsal vessel, the heart, which begins in the sixth abdominal somite and passes forward into the thorax. Here it gives rise to the aorta, which runs forward, ventral to the salivary glands to the head. The heart is very small and lies just below the dorsal wall above the intestine. In almost all of the specimens examined it was so badly collapsed that it was scarcely visible. Its walls are exceedingly thin and have very few muscle fibers. The alary muscles are very poorly developed. Four pairs of ostia were found; these were in the third, fourth, fifth and sixth abdominal somites.

RESPIRATORY SYSTEM.

Figs. 14 and 15.

There are three pairs of stigmata, one at the anterior end of the mesothorax, and one each on the first and seventh abdominal somites. The stigmata are quite large, and have a sieve-like covering to prevent the ingress of solid particles. From the stigmata on the mesothorax tracheæ are supplied to the head and its appendages, to the prothorax and fore limbs, and to the organs and appendages of the meso- and metathorax. The two stigmata on each side of the abdomen are connected by a large tracheal trunk, which runs along the abdomen near its lateral wall. From these trunks three branches are given off in each of the six anterior abdominal somites. One of these branches supplies the dorsal part of the somite, another the ventral part of the somite, and a third passes nearly straight into the body, going chiefly to the viscera. The two posterior somites of the abdomen are supplied by long tracheal branches which come from the stigmata on the seventh abdominal somite. The tracheæ are very small and thin walled, and the walls have a chitinous lining that shows spiral markings. They are supplied to the viscera very abundantly, and serve the double purpose of respiration and to keep the viscera in place.

FAT BODY.

The fat body is large in all stages of development. In the larva it fills all of the space between the viscera. It is made up of a frame-work of large cells, each of which contains a large drop-

let of fatty matter. In the older stages the most of the fatty matter has been absorbed, but the cells still persist.

HABITS.

The insects usually live in some part of the grass plant where they are protected from any disturbance. When a sheath is torn down so as to disturb them, they begin to run about seeking some place in which to hide themselves. If they are unsuccessful in their search, they remain practically still and bend up the abdomen as if ready to sting the intruder.

In the act of egg laying the female arches the body so as to bring her weight to bear upon the ovipositor, which is slowly worked down through the surface of the leaf into the under lying tissue. The egg is then passed down the groove on the surface of the ovipositor and lodged just beneath the epidermis of the leaf. This process takes about one and a half minutes for its completion. After an egg has been deposited, the insect moves off and begins to feed. It frequently happens that the serrated edges of the ovipositor become so firmly fastened in the tissues of the plant that the insect is unable to free itself and finally dies.

The insects attack a number of the common grasses during the season, but in the early months its ravages are mostly confined to the June grass, *Poa pratensis,* on which the results of its work are the most manifest. As the season advances it is found quite abundantly in timothy, *Phleum pratense,* and on several species of Panicum, Agrostis, and Festuca.

For treatment see page 128.

REFERENCE LETTERS.

ab abdomen.
abg abdominal ganglion.
ant antennæ.
antn antennal nerve.
cg cerebral ganglion.
cox coxa.
ei eye.
fbc cells of the fat body.
fem femur.
fl fore leg.
fw fore wing.
hd head.
hi hind-intestine.
hl hind leg.
ht heart.
hw hind wing.
hyp hypodermis.
ism intersegmental muscles.
lbm labium.
lhr labrum.
lm muscles of the legs.
ln nerves of the legs.
lp labial palp.
mi mid-intestine.
ml middle leg.
mp mouth parts.
mpm muscles of the mouth parts.
msth mesothorax.
mt malpighian tubules.
mtth metathorax.
mx maxilla.
mxp maxillary palp.
nc nerve cord.
oes œsophagus.
ov ovary.
ovd oviduct.
ovp ovipositor.
ovpm muscles of the ovipositor.
ovt ovarian tubes.
prth prothorax.
ps piercing setæ.
rg rectal glands.
sd salivary duct.
sg salivary gland.
st stigma.
stm sterno-tergal muscles.
tars tarsus.
thor 1 first thoracic ganglion.
thor 2 second thoracic ganglion.
thor 3 third thoracic ganglion.
tib tibia.
tr tracheæ.
troch trochanter.
trt tracheal trunk.
wc wing case.
wp rundimentary wing.

PLATE I.

Fig. 1. Larva.

Fig. 2. Pupa.

Fig. 3. Adult male.

Fig. 4. Anterior surface of head reconstructed to show the mouth parts in position.

See page 113 for reference letters.

PLATE I.

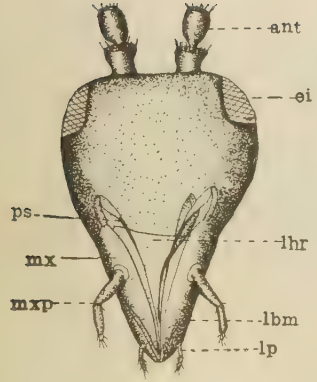


Fig. 4.

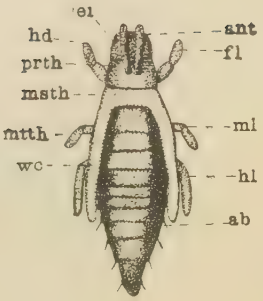


Fig. 2.

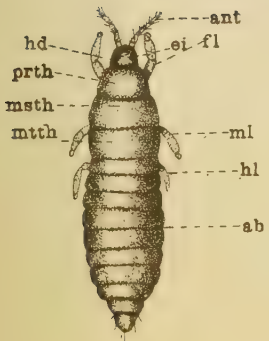


Fig. 1.

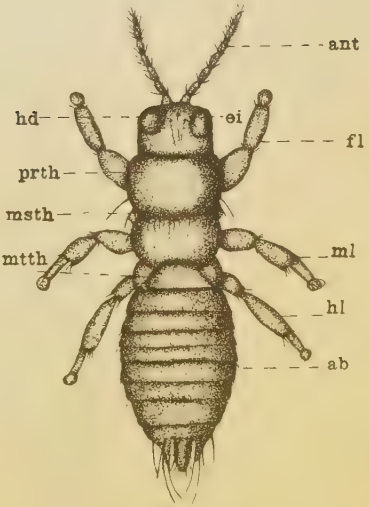


Fig. 3.

PLATE II.

Fig. 5. Adult wingless female.

Fig. 6. Adult winged female.

See page 113 for reference letters.

PLATE II.

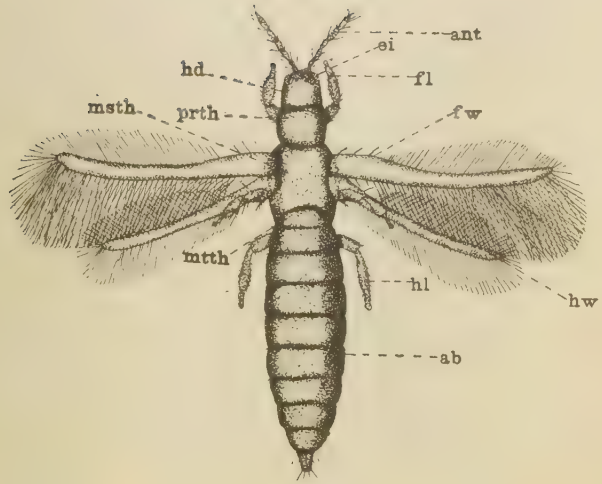


Fig. 6.

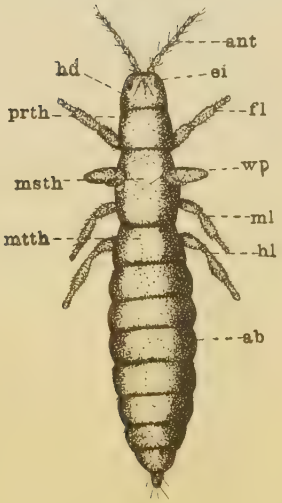


Fig. 5.

PLATE III.

Fig. 7. Adult wingless female with the dorsal part of the body removed.

See page 113 for reference letters.

PLATE III.

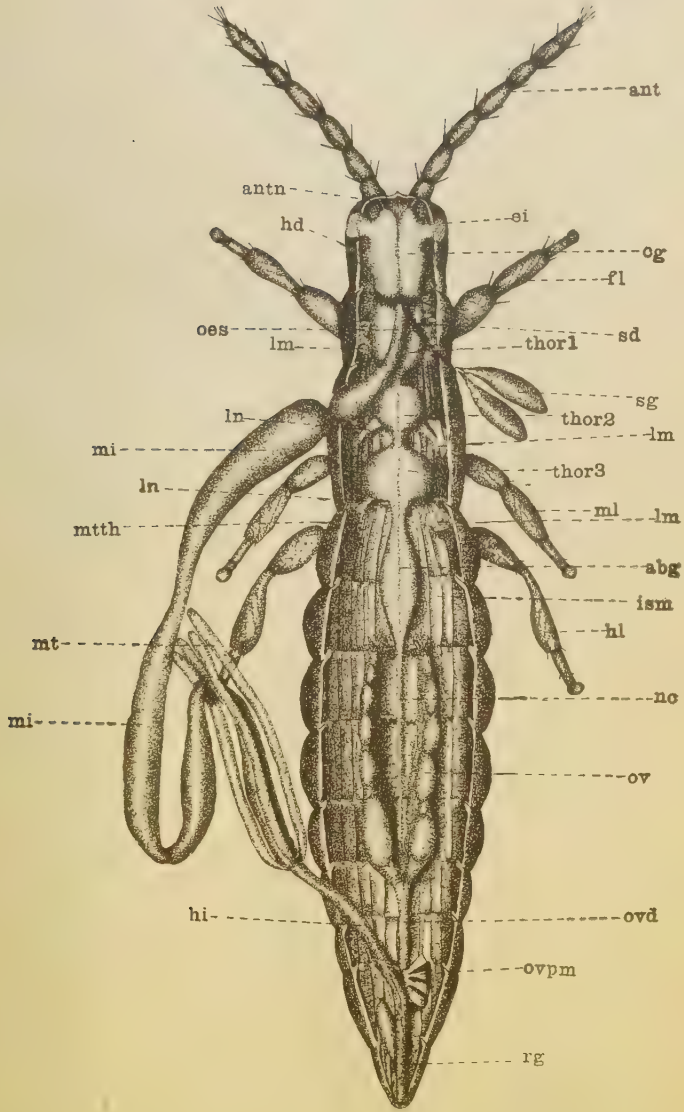


Fig. 7.

PLATE IV.

Fig. 8. Ventral wall of an adult insect showing the arrangement of ventral muscles.

See page 113 for reference letters.

PLATE IV.

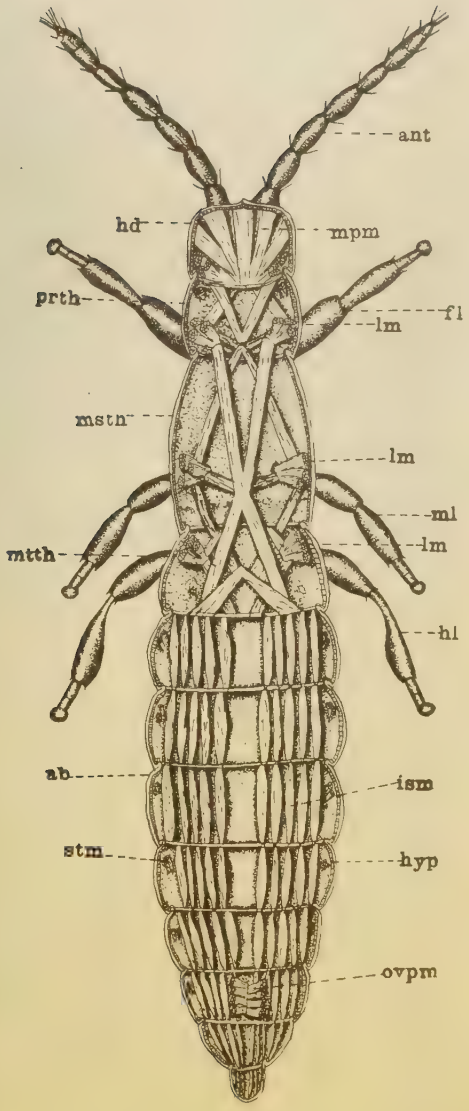


Fig. 8.

PLATE V.

Fig. 9. Sagittal section through the median plane of the body showing the arrangement of the ganglia.

Fig. 10. Sagittal section through a pupa a little to one side of the median line showing the attachment of the intersegmental muscles.

See page 113 for reference letters.

PLATE, V.

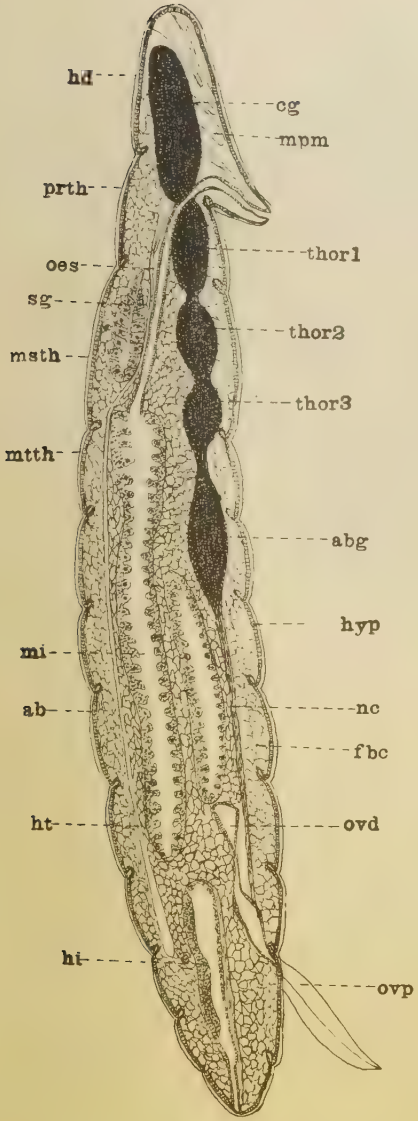


Fig. 9.

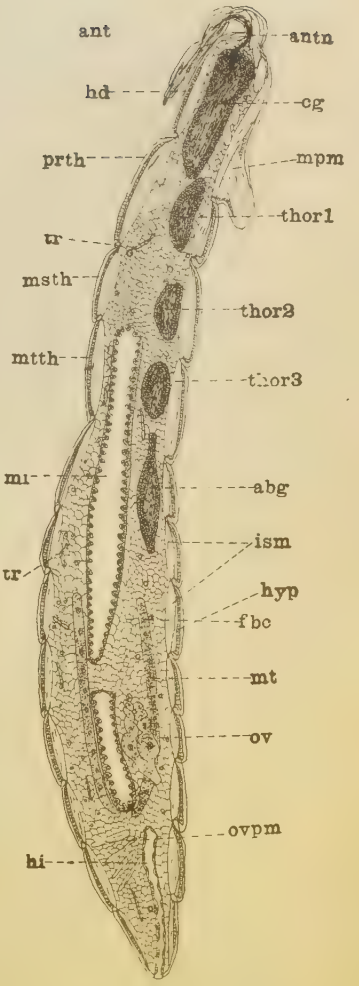


Fig. 10.

PLATE VI.

Fig. 11. Transverse section through the posterior part of the head of a wingless adult female.

Fig. 12. Transverse section through the posterior part of the first thoracic ganglion.

Fig. 13. Transverse section through the fourth abdominal somite of a winged adult female.

See page 113 for reference letters.

PLATE VI.

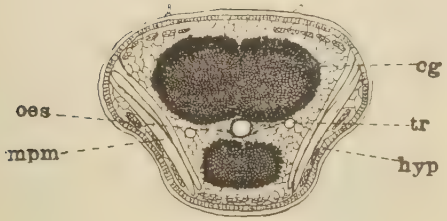


Fig. 11.

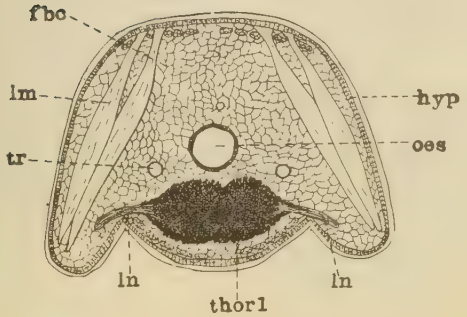


Fig. 12.

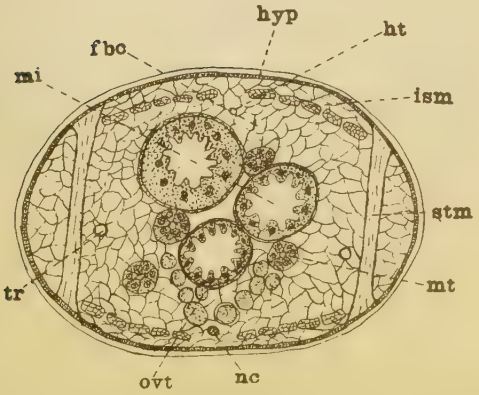


Fig. 13.

PLATE VII.

Fig. 14. Tracheal system of a wingless adult female (somewhat diagrammatic).

Fig. 15. Diagram of the distribution of the tracheæ in a typical abdominal somite.

Fig. 16. Fore leg of an adult wingless female.

See page 113 for reference letters.

PLATE VII.

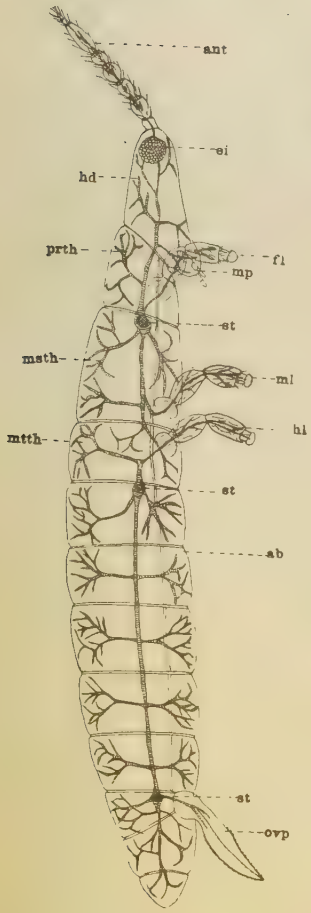


Fig. 14.

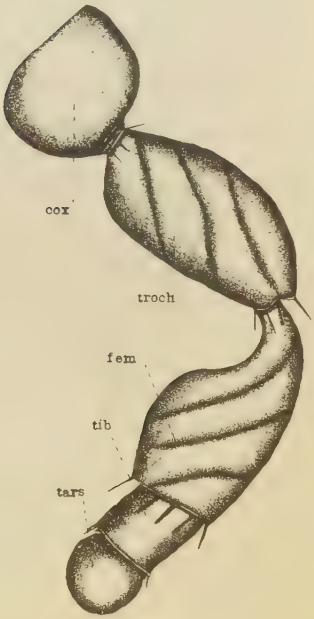


Fig. 16.

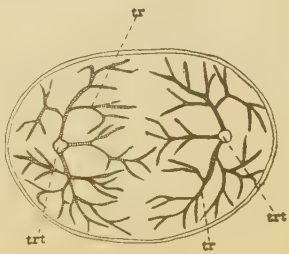


Fig. 15.

TREATMENT.

As the thrips feeds by sucking the juices of the plants, contact poisons, as kerosene emulsion, or whale oil soap, are the only ones which are of use in combating it.

Where only a small area is infested, one of the insecticides just mentioned or even a liberal application of water will prove successful in controlling the pest. When a large area is infested, the application of an insecticide is not feasible on account of the expense of materials and application. In such a case the burning of the dead stalks after the ground has frozen in the fall, so as to secure a close burn, without injuring the roots of the grass, may prove successful. With badly run out fields, which are the ones most likely to be badly infested, the best remedy is deep plowing in the fall or in the early spring before the grass has started. If this is followed by thorough cultivation, none of the insects will be able to make their way to the surface of the ground.

THE CHINCH BUG IN MAINE;*

With Some Observations and Experiments.

H. W. Britcher.

For nearly a century and a quarter the chinch bug, *Blissus leucopteris,* Say, has been recognized as a pest in the United States. In 1785 so much damage was done in North Carolina that in some districts wheat growing was abandoned. In 1809 another serious visitation occurred in that state and during a third destructive period in 1839 losses were also reported in South Carolina and Virginia. Between 1845 and 1850 injuries were reported from Illinois, Indiana and Wisconsin and during the few following years its destructive presence became known in other states. The loss due to its ravages in 1887 in Kentucky, Ohio, Indiana, Illinois, Minnesota, Iowa, Missouri and Kansas was estimated at $60,000,000, and it is further estimated that the total losses for the period from 1850 to 1898 were $330,000,000, chiefly in the above nine states. Although it occurs in largest numbers and does its chief injury in the states of the Mississippi Valley, its presence is known in every state of the Union except Oregon, Washington, Montana, Idaho, Nevada, Utah and Arizona. The crops, whose partial or total destruction has resulted in such enormous losses, include wheat, barley, rye, corn and several grasses.*

DESCRIPTION.

I

Fig. 11. CHINCH BUG. The short upright line shows natural length.

The chinch bug, which by its presence in vast hordes is able to cause such immense losses, is a near relative of the group of bugs popularly known as "stink bugs" and has, in common with them, the habit when disturbed of emitting a peculiar odor. When full grown it is about one-sixth of an inch long and one-twentieth of an inch broad. It is black in color, with a flat back upon which rest the wings, which are whitish in color with a black spot at about the middle of the external edge of each. In some individuals

* The first part of this bulletin is largely a compilation from Bulletin No. 15 of the Division of Entomology of the U. S. Department of Agriculture, entitled The Chinch Bug, by F. M. Webster.

Entomology No. 20.

the wings cover the whole abdomen while in others they are only long enough to cover from one-third to two-thirds of the back. These latter are known as the short-winged forms, while the former are spoken of as the long-winged forms. Both forms are covered on the body and legs with very fine hairs and are apparently alike in all respects except the size of the wings.

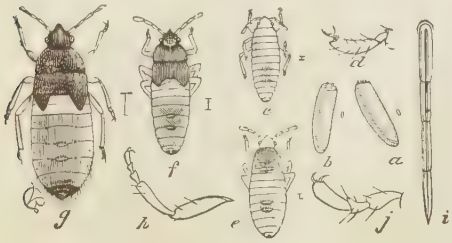


FIG. 12. CHINCH BUG, LARVA, PUPA AND EGG.

a and *b*, eggs; *c*, young larva; *d*, tarsus of same; *e*, larva after first molt; *f*, larva after second molt; *g*, pupa; *h*, leg; *i*, beak or tubular mouth; *j*, tarsus of mature bug. The short line at the right of each figure shows the natural length (after Riley).

The eggs are white in color, about one thirty-third of an inch long, and hatched in about two weeks after laying. The newly hatched larva is yellowish with a red spot on the back. Soon the whole body becomes reddish in color and after the first moult is bright vermillion, except the first two somites of the abdomen, which remain yellow, and the head which is dusky. After the second moult the head becomes still darker and the vermillion changes to duller red. After the third moult the head is brownish black, the abdomen grayish black and the legs blackish as in the adult stage, which is reached after the next moult. After the egg is laid about sixty days elapse before the adult stage is reached.

HABITS.

During the winter the bugs hibernate beneath such convenient material as loose bark and chips, dried leaves, corn shocks, the weeds of fence corners and similar places, and they may frequently be found, more or less closely crowded, low down among the stems of clumps of wild rushes and grasses, often working their way down between the stems and the soil. During the warm days of May and June they leave these quarters and become active, the long-winged individuals frequently flying some distance to fields favorable for egg laying. The eggs are deposited near or below the surface of the ground on the stems or roots of the food plants. The egg laying season extends over a period of about three weeks and each female may lay from three hundred to five hundred eggs. After hatching the young

usually remain below the surface of the ground, sucking the juices from the bases of the stems. When nearly mature they sometimes move higher up and so come to work above ground. If feeding in grain the whole brood, larvæ and adults, crawl off into nearby fields of corn or other food material when the grain is cut. They have been known to thus travel *en masse*, for over a quarter of a mile. There is also usually a migration from the feeding places to suitable places for hibernation during the warm days of early fall.

ENEMIES AND CHECKS.

It is reported that the chinch bug is devoured in considerable numbers by the common quail in some parts of the Central and Western States. Its other bird enemies include the prairie chicken, red-winged blackbird, catbird, brown thrush, meadow lark and house wren.

In Oklahoma Pekin ducks have been found to eat them readily. Frogs are also known to eat them, and a few insects, including lady-birds, one or two beetles, and two or three near relatives of the chinch bug itself also feed upon them to some extent.

Certain fungi have been found to attack chinch bugs normally and with one or two of these field experiments have been carried on rather extensively in some parts of the West, notably in Kansas and Indiana. The fungus has been grown in quantity in the laboratory under conditions favorable for its rapid multiplication and the spores have then been sent to localities in which chinch bugs were abundant and there sown among the bugs. In many instances the healthy bugs, in both larval and adult stages, have rapidly become infected with the fungus and have been speedily killed by its growth within them. However, the fungus requires for its own activity continued wet or damp weather, and appears to be practically worthless except under such conditions.

The weather itself is in all probability the most powerful factor in checking the increase of the chinch bug. The adult bug seems very little affected by moisture, but the larval insect, in all stages, more especially the earlier ones, are very soon killed by wet weather. If, therefore, frequent rains occur during the larval season of early summer, the bugs are considerably reduced in numbers and the amount of injury is much less than during dry seasons.

THE CHINCH BUG IN MAINE.

The chinch bug has been in Maine for some time, its presence being known in the grass lands about Fryeburg as much as thirty-five years ago.* During the past ten years it has been reported from Bridgton, Bethel, Jackman and Orono, at which last named place it has been found in a pasture near the village and also under leaves in woods on the University grounds. The region about Fryeburg is apparently the only locality in the State where the injury has been sufficient to attract general attention. Here it probably does slight damage every year without attracting notice. Occasionally there occurs a year or two especially favorable to the multiplication of the bug and then the damage wrought becomes conspicuous. In 1892 considerable injury was done and on the sixth of September a vial of the insects was sent to the Experiment Station for examination. They all proved to be in the pupa stage.

During the latter part of the summer of 1901 complaints were received at the Experiment Station that the chinch bugs were again causing an unusual amount of injury about Fryeburg. An examination of the conditions existing there during the latter part of September showed that the chief injury had been to timothy and hungarian grass, although corn and oats were in some instances attacked, as were also witch grass and barn grass. Timothy was completely killed over areas varying in size from a few square yards to others of several acres in extent. In some instances clover and witch grass had grown up in these spots. Barn grass growing among corn was completely killed and witch grass was killed to the ground, but grew up again as the bugs passed onward.

Although the damage for the year had ceased the bugs were easily found; in one case clustering in large numbers under the dead leaves, stems and other debris among the clover immediately bordering a spot on which the timothy had been killed; in another case crowding in and about the clumps of beard grass and sedge grass bordering a strip of hungarian grass. In such places as these and under dead grass and weeds about fence corners, under manure spread on the fields in the fall and not

* Report Maine Agricultural Experiment Station, 1892.

plowed under, under masses of dead leaves and rubbish of all sorts, the bugs pass the late fall and winter months, lying apparently dead during cold weather, but quickly coming into activity during the warm days of late spring.

REMEDIES.

As the chinch bug works chiefly among grass crops in Maine, many of the remedies employed against it in the West are practically worthless here. As the amount of injury during any year depends partially on the number of bugs which pass the preceding winter in safety, perhaps the best methods to use against them are such as are easily applicable during the winter months. The following methods, if applied before the ground is covered with snow, would probably prove reasonably effective.

1st. *Burning.* When there is considerable clover mixed with the timothy or hungarian grass, the bugs are very likely to winter over beneath the clover which borders for a few feet or yards immediately upon the spot where they have stopped injuring the grass. If such a strip be mowed closely by hand and allowed to dry for a few days it may be burned over and quantities of the bugs will be killed. If this burning be done after the ground is frozen, little, if any, injury will thereby be done to the grass. All rubbish such as dried grass and weeds at the edges of the fields, brush heaps, dead leaves, bark and chips, clumps of wild grasses, sedge grasses, etc., in nearby fields should be burned as completely as possible.

2d. *Spraying.* Chinch bugs are quickly killed by kerosene or kerosene emulsion, but it is essential that it be thoroughly applied. The bugs are so protected by the clover and grass that it is almost impossible to reach them by ordinary spraying. Sprinkling freely over the infested spots will usually be effectual although it may kill the grass also. Clumps of wild grass or sedges in which careful examination shows the bugs to be abundant might be sprinkled thoroughly with kerosene and then burned, thus killing the bugs which had crowded deep down among the bases of the plants, where the flames alone might not reach them.

3rd. *Plowing.* Where bugs are found in considerable numbers at the edges of spots which they have eaten over, they may be destroyed by plowing under the strip in which they are hiding.

Deep plowing, however, is necessary, followed by dragging and rolling in order to completely cover all vegetation and close up all holes or passages through which the bugs might make their way to the surface.

If used promptly and thoroughly, the two latter methods are also applicable when the bugs are found to be working during early summer, and are all the more effective then because the bugs do not scatter over the whole field but stay together in comparatively small areas or strips, and if they are promptly killed over such patches further injury for the season will be very much lessened.

OBSERVATIONS.

The winter of 1901-1902 was unusual in some of its features. Snow fell on the 14th of November and again on the 26th and also on December 4th, the total amount aggregating over two and a half feet. The maximum temperature did not rise much above freezing during this time and the snow lasted. On December 10th began two weeks of rainy weather during which over four inches of rain fell and the fields were washed bare of snow. During the last week of December the maximum day temperature varied from 29° to 50° and the minimum night temperature from 2° to 33°, and during this time eight inches of snow fell, followed a day later by one and a quarter inches of rain. The minimum temperature of 2° occurred the night before the rain, while the snow still remained on the ground. From December 16th to 23rd, while the ground was bare, the maximum day temperature had varied from 13° to 21° and the minimum night temperature from 5° below zero to 12° above.

During the first week of January two inches of snow fell, the minimum night temperature only once rose above 6° and the maximum day temperature only once above 22°, and high winds prevailed. Several snow falls occurred before January 20th, aggregating nearly a foot and a half. During the following week over two inches of rain fell, the temperature was higher and the ground again became bare. During February enough snow fell to keep the fields slightly covered, although it was badly drifted by the high winds which followed each snow fall.

About the 1st of November chinch bugs were found in considerable numbers in a pasture which was separated from a tim-

othy field by the width of the public road. The bugs were found beneath the debris collected in a brush heap by the road side, beneath the dead cedar twigs and leaves under one or two young cedars growing in the fence and in clumps of rushes (*Juncus*) growing in a moist situation in the pasture. In the rushes the bugs were crowded among the bases of the stems, working their way even lower down than the surface of the ground. One clump about six inches in diameter was cut out an inch or so below the surface of the ground and picked to pieces and found to contain one hundred and fifty-six bugs. On December 14th ten bugs were taken from beneath a strip of bark lying on the ground and twenty-two from a *Juncus* clump six inches in diameter.

The melting snow and the rains of the last week in December flooded all except one edge of the *Juncus* patch. The sudden cold of the first days of January froze the water over this area three or four inches thick. The water beneath the ice then settled away, leaving an air space. The rain of January 21st and 22nd, together with the melting snow, filled this space and then overflowed through openings about the *Juncus* clumps. Through these openings chinch bugs were washed out and left stranded on the surface of the ice as the water flowed away. During the afternoon of January 23rd sixty-eight such bugs were picked up off the ice. All were making feeble leg movements, strong enough in some cases to cause very slow progression. Fifty-three of these bugs were short-winged. (See Experiment 6.) On the morning of the same day thirty-two long-winged forms and two short-winged forms were taken from beneath a flat log frozen to the ground. All were thickly covered with frost crystals and made no responsive movements when picked up, but all became active after being in the laboratory a few moments. (See Experiment 5.)

On the 27th of January rain washed more bugs out onto the ice. Many of these were frozen into the ice during the two following days, during which the maximum temperature did not rise above 13° On January 29th six of these frozen bugs, all short-winged, were chopped out of the ice and slowly thawed out. None of them gave any signs of life. On the same day ten long-winged and one short-winged forms were taken from among leaves beneath a loosely attached board. When thawed

out only three long-winged forms failed to show signs of life. Six were able to walk about actively, while two were unable to walk but could move their legs feebly.

On February 14th two clumps of *Juncus* were chopped out. The first was three inches in diameter and contained fifty long-winged bugs and ten short-winged ones. The second clump was six inches in diameter and contained forty-two long-winged forms and eight short-winged ones.

On April 5th, after three weeks of mild and rainy weather, thirty-six long-winged and twenty-nine short-winged forms were taken from the under side of a piece of board two feet long and five inches wide. They were clustered in groups and moved off readily when disturbed. A few bugs were also found in clumps of *Juncus* and these were less active than those beneath the board.

On October 1st, 1902, the chinch bugs were again found in winter quarters in the same locality as during the fall of 1901. Eighteen short-winged and two long-winged forms were shaken out of a piece of *Juncus* clump. On October 15th four hundred and twenty-nine short-winged and forty-four long-winged forms were taken from beneath cedar debris and on October 31st fifty-eight short-winged and fourteen long-winged forms were taken from the same locality.

Thus, of the five hundred and sixty-five bugs collected during October, 1902, only sixty were long-winged.

Of the seven hundred and sixty-three bugs collected during the winter of 1901-1902 two hundred and forty-six were short-winged, three hundred and thirty-nine were long-winged and the remaining one hundred and eighty-eight were not examined as to length of wings.

The odor of the bugs collected and experimented with during October seemed much stronger and more persistent than that of bugs collected and experimented with during the winter.

EXPERIMENTS.

In order to test the powers of the chinch bug to withstand severe and unusual conditions, the following experiments were made:

Experiment 1. Twenty long-winged and five short-winged forms were frozen in an open box from January 17th to 23rd when they were thawed out by a cold rain. None of them showed any signs of life.

Experiment 2. Seven long-winged and five short-winged forms were frozen in a block of ice from January 17th to 23rd. No signs of life were shown after thawing out.

Experiment 3. Fifteen long-winged and eight short-winged forms were packed in snow and frozen from January 18th to 23rd. After thawing out two long-winged and four short-winged forms walked about actively; the rest did not revive.

Experiment 4. Ten long-winged and six short-winged forms were frozen in an open box for fifteen hours. Upon thawing out two gave no signs of life. After being kept for nine hours at a temperature of 65° the fourteen surviving bugs were refrozen for fifteen hours and then thawed out, when five long-winged and three short-winged forms revived. After nine hours at a temperature of 65° they were refrozen for fifteen hours, during which time the minimum temperature sank to 16° below zero. When thawed out all revived, but during the following nine hours at 65° temperature the three short-winged forms and two of the long-winged ones died. The remaining three long-winged forms were then again refrozen for fifteen hours, after which none revived.

Experiment 5. Thirty-two long-winged and two short-winged forms taken from beneath a log on January 23rd were kept at the ordinary temperature of the laboratory in a covered pasteboard box. Several thicknesses of filter paper were laid on the bottom of the box and well moistened twice daily for eight days, when only two bugs remained alive.

Experiment 6. Fifty-three short-winged and fifteen long-winged bugs picked up from the ice on January 23rd were kept at laboratory temperature in a covered box with filter paper moistened twice daily for eight days. Nineteen long-winged and eight short-winged forms were alive at the end of that time. These twenty-seven were continued at the same temperature but without moisture for seven days longer when five short-winged forms still remained alive.

Experiment 7. Three long-winged forms were frozen for twenty hours in a dry glass tube. None revived when thawed out.

Experiment 8. Three long-winged forms were frozen for twenty hours in a block of ice. None revived after being thawed out.

Experiment 9. Five long-winged and three short-winged bugs were frozen between sheets of wet filter paper for seventeen hours. Four long-winged and one short-winged forms revived when thawed out.

Experiment 10. Seven long-winged and one short-winged forms were frozen in a block of ice for seventeen hours. None revived when thawed out.

Experiment 11. Five long-winged and two short-winged bugs were frozen in a dry glass tube for seventeen hours. Three long-winged forms revived after thawing out.

The minimum temperature for experiments 7 and 8 was 2° and the maximum was 16°. For experiments 9, 10 and 11 the minimum was 4° and the maximum 10°.

Experiment 12. A small clump of *Juncus* was cut from the ground, wrapped in paper and exposed for twenty-five days on the north side of a building where it received no sun rays. It was then picked to pieces and sixteen bugs were found, of which eleven short-winged ones were dead, and three short-winged ones and two long-winged ones were alive. During this exposure the minimum temperature was 15° below zero and the maximum was 45°.

Experiment 13. A clump of *Juncus* was cut out of the ground, wrapped in paper and exposed on the north side of the building for forty days, when it was picked to pieces and found to contain fourteen long-winged and thirty-two short-winged bugs which were dead, and nine long-winged and seven short-winged bugs which were alive. The minimum temperature for the forty days was 15° below zero and the maximum was 52°.

Experiment 14. Five long-winged and four short-winged bugs were completely submerged in water for three hours, after which all revived, the short-winged forms becoming active first. They were kept dry for seven hours and then again completely submerged for eleven hours. All revived, were kept dry for twelve hours and again completely submerged for seventeen hours. All revived except one short-winged individual. After being dry for twenty-four hours the remaining eight were submerged for twenty-five hours, after which one long-winged and one short-winged form failed to revive. Another short-winged form died during the day. The remaining five were submerged for thirty hours, after which they were kept dry for eighteen

hours, at the end of which time only the one short-winged individual was alive.

Experiment 15. Eleven long-winged and three short-winged bugs were completely submerged for twenty-five hours. All revived in from twenty to seventy-five minutes. After being dry for eighteen hours they were again submerged for thirty hours, after which none revived in less than an hour and after being dry for eighteen hours three long-winged and two short-winged forms were dead. The remaining nine were then submerged for fifty hours after which four long-winged forms revived within ninety minutes. Three of these were still able to move about at the end of eighteen hours.

Experiment 16. Four long-winged and four short-winged bugs were submerged for twenty-seven hours. All revived, but at the end of eighteen hours one short winged individual was dead. At the end of fifty hours longer the remainder were all found to be dead.

Experiment 17. Six long-winged and ten short-winged bugs were submerged for fifty hours, after which all revived except one of each form. After being dry for eighteen hours, all except one long-winged and two short-winged forms were walking about actively.

Experiment 18. Twenty long-winged and five short-winged bugs were submerged for seventy-five hours. There were no signs of reviving at the end of three hours, but at the end of twenty hours twelve long-winged and four short-winged forms were moving their legs, one of each form being able to walk about.

Experiment 19. Thirteen long-winged and two short-winged bugs were kept for seventy-five hours in a tightly corked two-dram vial. At the end of forty-eight hours all were inactive, but all revived within two hours after the end of the test.

Experiment 20. Eight long-winged and three short-winged bugs were frozen in a dry glass tube for sixteen hours. None revived in less than two hours, but at the end of six hours all but one of each form had revived, but none were able to walk about.

Experiment 21. Four long-winged and seventeen short-winged bugs were submerged for twenty-six hours after which all but one revived in from one to four hours.

Experiment 22. Five long-winged and fifteen short-winged bugs were submerged for forty-eight hours after which nine short-winged forms revived in from two and a half to six hours. Only two however were able to walk about.

Experiment 23. Eight long-winged and twenty-two short-winged bugs were submerged for sixty-eight hours. After being dry for eight hours only one long-winged and two short-winged forms had revived and these were unable to make any but very feeble movements.

Experiment 24. Fifteen short-winged bugs were placed in a tightly closed two-dram vial. In six hours they had ceased all movements and lay as if dead. After twenty-four hours five were taken out, but failed to revive at the end of three hours. After forty-eight hours the other ten were taken out. They showed no signs of reviving at the end of eight hours.

Experiment 25. Fourteen long-winged bugs were placed in a tightly closed two-dram vial. At the end of thirty hours all were active. At the end of fifty hours all were still able to move about feebly. At the end of seventy-two hours all but one were still able to move their legs feebly but not able to walk about. They were then taken from the vial and after half an hour all were able to walk about.

Experiments 1-20 were performed during January and February, 1902, and experiments 21-25 during October, 1902.

CONCLUSIONS.

From the foregoing observations and experiments the following conclusions seem reasonable:

The hibernation of the chinch bug is not a period of prolonged or continuous torpidity, but a period during which the torpidity may be broken by warm weather, when the bug becomes capable of active movements.

Complete submersion in water, even for a considerable period is not necessarily fatal.

Freezing while submerged in water is almost surely fatal.

Freezing while exposed to a dry atmosphere is generally fatal.

Freezing in a moisture laden atmosphere is only occasionally fatal.

CANKER WORMS.*

W. M. Munson.

Every year come complaints of the defoliation of orchard and shade trees in May and early June. This trouble is usually caused by small slender inch-worms or measuring worms which from their effect upon the foliage are commonly called "canker worms." These larvæ appear in immense numbers just as the leaves put forth in the spring. They are so small in the beginning, however, that they are often overlooked and the cause of the backward appearance of the trees is not recognized. When they first appear, and while not more than one-eighth to one-fourth of an inch long, the larvæ gnaw small holes in the young leaves. As they increase in size the entire leaf, except some of the larger veins, is destroyed and the trees if badly attacked look as if swept by fire.

Two distinct species of insects are concerned in this destructive work, viz., the fall canker-worm and the spring canker-worm. The habits of the two insects are much alike and to the casual observer there are no distinguishing marks. The striping of the larvæ is slightly different, however, and the spring canker-worm has three pairs of legs under the rear portion of its body while the other has but two. Both species are natives of this country and are about equally destructive where they occur. The spring canker-worm is, however, the more widely distributed, ranging from Maine to Iowa and southward to Texas.

THE SPRING CANKER-WORM *(Paleacrita vernata.)*

The male moths of this species have rather large, thin, silky wings, about one inch across when spread. The general color is bluish gray. A well defined row or band of light markings

* Paper from the [illegible] Entomology No. 20a.

near the outer margin of the front wings, and three darker, irregular bands, across the same wings, together with the slightly lighter color and absence of markings on the hind wings, are characteristic features. The inconspicuous female moths are wingless and, because of this fact, the spread of the species is very slow, occurring mainly by the transportation of nursery stock infested with eggs.

The moths usually emerge from the ground early in the spring—about April, or farther south, in March—and the females climb up the trunks of trees to deposit eggs. The eggs, which are shaped something like hens eggs and are about the size of "fly specks," are deposited in irregular masses, usually partially concealed by loose pieces of bark. They hatch about the time the leaves unfold; the time varying with the locality and the season. The young larvæ are voracious feeders and they grow rapidly, usually attaining full size in from three to four weeks from the time of hatching. Upon reaching full size they drop to the ground, burrowing beneath the surface to a depth of two to five inches. Here each one forms a cell, lined with silk which it spins, and soon transforms to the chrysalis stage, where it remains until the following spring, when the adult moth emerges as before.

THE FALL CANKER-WORM.—*(Alsophila pometaria.)*

The fall canker-worm so closely resembles the other species as to be frequently mistaken for it. For all practical purposes they may be considered together, but the fall canker-worm is more distinctively a northern insect. As in the other species, the female moth (see figure 39 *b*) is wingless, but in this species she lacks the hairiness which characterizes the other. The male moth (figure 39 *a*) has two light bands across the front wings instead of the single one of the preceding, and the rear wings are slightly shaded. The larvæ of this species also, besides having three pairs of legs under the hind end of the body, as shown in figure 40 *f*,

Figure 39.—Fall canker worm; *a*. male moth; *b*. female moth; *d*. egg cluster.

have a broad, dark stripe along the back, as opposed to the narrow markings of the other species. The eggs, which are slightly larger than in the previous species, somewhat resemble small flower pots and are attached to the bark, in exposed situations, in masses of from 60 to 200, placed side by side as seen in figure 40, *e*. The eggs highly magnified, are shown in figure 40 *a* and 40 *b*.

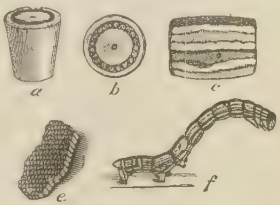


Figure 40 Fall canker worm: *a*, and *b*, eggs, enlarged; *c* segment of larva enlarged; *e*, egg cluster; *f*, full grown larva.

The eggs are deposited in fall or early winter (sometimes in mild winters as late as March). They hatch about the same time as those of the other species and the larvæ act in a similar manner, entering the ground about the same time. Instead of forming a cell lined with silk, however, this species spins a tough cocoon, and the moths come forth and begin laying eggs in October and November.

HOW TO FIGHT CANKER-WORMS.

The natural enemies of the canker-worms, including Ichneumon, Tachina and Chalcid flies, certain wasps and beetles, and various kinds of birds, are so numerous as to prevent serious damage save in exceptional years. In the absence of these natural enemies, however, or when the weather conditions are specially favorable to the increase of the worms, active measures must be taken to save the trees.

One of the surest preventive measures is to place a band of tarred paper about the tree in March and smear it with printers' ink, thus preventing the ascent of the female moths and the deposit of eggs. In case the bark is very rough, it should be scraped smooth to prevent the insects from crawling up behind the paper. The ink must be renewed often enough to prevent hardening, or it will be of no use. If the fall canker-worm is present, of course the treatment must begin in October. If the trees are already attacked, jarring the limbs will cause many of the worms to spin a thread and drop to the ground. If the band of printers' ink is in place they will be unable to return to the attack and may be destroyed.

The surest way of fighting this pest, however, is by spraying with Paris green or arsenate of lead (Disparene). For this purpose the pump should be powerful enough to develop a pressure of at least 60 pounds to the square inch, and all parts should be made of brass and carefully adjusted. The formulas for use on ornamental trees are the same as those which have heretofore been recommended for use in the orchard, *viz.:* (1) Paris green, 1 pound; lime, 6 pounds; water, 100 gallons; or (2) arsenate of lead or Disparene, 6 pounds; water, 100 gallons. The lime is added to the first formula to prevent injury of the foliage by the Paris green, and should in no case be omitted. The lead arsenate acts slower as a poison than does Paris green, but it adheres to the foliage better. It is important that spraying be done *at once* when the attack of canker-worms is discovered, as the insects are much more difficult to kill as they increase in size.

If more explicit directions for spraying are desired, send to the Experiment Station for directions "How to Fight Apple Enemies."

PLANT-HOUSE ALEYRODES.*

Aleyrodes vaporariorum Westw.

Lewis R. Cary.

During the summer this species of Aleyrodes lives chiefly out of doors on garden plants, and in the fall larvæ and pupæ are brought into the greenhouse with the plants, and some of the adults fly in. Here they begin to breed freely as soon as crops are started, multiplying fast enough to keep pace with the growth of the plants. The eggs are very abundant on the under surface of the leaves of various greenhouse plants, frequently occurring in numbers so great that they give the under side of the leaves a decided brown cast.

The curious manner in which the eggs are deposited has been already observed. Mr. W. E. Britton describes the process * with reference to Reaumur's observation of the habit in *Aleyrodes chelidonii*. The female inserts her beak into the leaf and with this point as a center she swings about, describing a circle with her ovipositor. The number of eggs in such circles varied in the different instances noted here from six to ten. Much of the time eggs were deposited promiscuously over the leaf. On rough hairy leaves, like those of the Abutilons, the eggs were found without definite arrangement, which agrees with Mr. Davis's observation that on plants like Ageratum the eggs are deposited singly.

* Report of the Connecticut Agricultural Experiment Station, 1902, p. 153.

Note. These studies were made by Mr. Cary in 1902-3 in the biological laboratory of the University of Maine, under the direction of Dr. G. A. Drew, professor of biology in the University and at that time zoologist to this station. The station greenhouses have been infested with this species of Aleyrodes for several years and thus afforded ample material for the study. They were most abundant on the leaves of tomatoes and cucumbers, but other kinds of plants were more or less infested.

* Papers from the Maine Agricultural Experiment Station Entomology No. 21.

TECHNIQUE.

The material was fixed with hot water, alcoholic-picro-sulphuric, and alcoholic picro-corrosive acetic. The two latter solutions when used hot gave the best histological results. Some eggs in the earlier stages which were fixed in absolute alcohol gave very satisfactory results. In all cases the material was washed immediately after killing in 70 per cent alcohol.

In studying the different stages as entire transparent objects the best results were obtained by pricking each specimen with a very fine needle, and staining either in Grenacher's borax-carmine or alcoholic cochineal for twenty-four to forty-eight hours. Then the material was washed with 70 per cent alcohol acidulated with a few drops of hydrochloric acid for two or three days, or until it was bleached sufficiently. Xylol was used for the clearing medium as it gave whiter and more transparent mounts than either clove or cedar oil.

In sectioning the younger stages, Dr. Drew's method for orienting small objects was very helpful.* The eggs to be sectioned were stained as for whole mounts, but were not washed out as thoroughly. They were then cleared in clove oil, mounted on the tracing cloth and finally cleared in xylol before transferring them to the paraffin bath. By this method good series of sections were obtained of all the stages. The sections were finally stained on the slide with Mayer's haemalum or iron haematoxylin.

EMBRYOLOGY.

The surface of the eggs is smooth and without any markings. When newly laid they are creamy white or very light green, but in two or three days they become darker, growing almost black before the time of hatching. The color change starts from the pointed end of the egg and extends over the surface. As will be seen from Figs. 41, 44 and 48, the eggs are elongated oval, one side being a little concave. The body of the egg is from .2 to .25 millimeters in length, and from .085 to .1 millimeter in diameter through the thickest part. A short narrow stalk at the

*Drew, Gilman A. A modification of Patten's method of imbedding small objects for sectioning in definite planes. Zoologischen Anzeiger, Bd. XXIII, No. 611, 1900.

broad end of the egg attaches it to the leaf and serves also as the external part of the micropylar apparatus. The lumen of the stalk is filled with protoplasm, which is in direct communication with a space in the end of the egg containing a mass of granular protoplasm in which the nucleus and polar bodies are situated. This space is separated from the yolk by a distinct membrane. See Fig. 44.

The yolk (Fig. 44) is composed of a great number of small, nearly spherical bodies, each consisting of a vesicle containing a viscid coagulable substance which stains deeply with haematoxylin or carmine. The yolk granules are arranged so that there are many comparatively large spaces which are filled with only fluid left between them. The oil globules are scattered evenly through the substance of the yolk. Over the whole surface of the yolk the peripheral protoplasmic layer is thin and inconspicuous.

Maturation of the egg takes place within the ovarian tubes of the female. In the mature egg the polar bodies lie in the chamber at the posterior end of the egg which contains the nucleus and undifferentiated protoplasm. The eggs are fertilized in the vagina of the female. The spermatozoon moves up through the protoplasm contained in the stalk of the egg, while the female pronucleus moves down and comes to lie at the entrance of the stalk. Immediately after the act of fertilization, the protoplasmic contents of the stalk shrivel and dry up. When the two pronuclei have fused, the resulting nucleus migrates back to the center of the mass of protoplasm and at once begins active division. The nuclei resulting from the first few divisions begin to migrate toward the periphery of the egg, keeping an arrangement conforming very nearly with the shape of the original protoplasmic vesicle. The wall of the vesicle disappears as the nuclei approach it.

Each of the nuclei resulting from the frequent divisions is surrounded by some of the protoplasm present in the vesicle. As the nuclei migrate farther and farther from their point of origin, it necessarily happens, on account of the location of the parent nucleus, that they first reach the surface of the yolk in the posterior part of the egg. When the nuclei reach the surface of the yolk they begin to arrange themselves regularly in the thin layer of protoplasm there present. The protoplasmic layer

increases in thickness at the time of the arrival of the nuclei. This thickening seems to be due to the taking up of the protoplasm which accompanies the nuclei in their migration through the yolk. As the nuclei increase in number they become crowded and press outward, forming little protuberances on the surface of the egg. Gradually, due to the increase of nuclei within, the outside walls of the protuberances approach each other and finally fuse to form the cell walls of the blastoderm. The inner wall of the cells appears later and seems to be formed by the hardening of protoplasm at that point.

The blastoderm extends rapidly over the surface of the yolk from the point where the nuclei first came to the surface. Before the blastoderm has come to cover the whole surface of the yolk, it has commenced to thicken over a small area on the ventral (concave) surface of the egg, a little in front of the posterior end. This thickening increases in size and forms the embryonic disc. In a short time a slight invagination appears at the centre of the disc. The invagination deepens rapidly and becomes directed toward the anterior end of the egg. The cells of the anterior limb of the invagination increase in length and thickness, while those of the posterior limb become very much flattened. The invagination deepens by the addition of cells at its inner end, and the space between the two limbs of the invagination, the amnionic cavity, becomes reduced to a narrow lumen open to the surface at the point where invagination began. This opening continues to grow smaller as the blastoderm folds approach each other over the point of invagination. See Fig. 47.

During the early part of the first day the folds of the blastoderm now marking the amnion and serosa come together over the mouth of the invagination. The two folds fuse at the point of contact, but the inner and outer layers soon separate from each other. The amnion however continues to remain almost in contact with the serosa so that there are only a few yolk granules between them at any time. The embryo, therefore, is of the superficial type, such as had been described by Metschnikoff* for Corixa.

Sometimes before the closure of the invagination has taken place there begins to be formed on the dorsal side of the germ

*Metschnikoff E. Untersuchungen über die Embryologie der Hemipteren. Zeits. für Wiss. Zool., Bd. XVI, 1886.

bands a shallow median groove. Certain cells in the vicinity of this groove seem to lose their epithelial nature and pass downward until they come to be below the surface layer of cells. The cells which go to make up the region of the groove pass down and out to form a complete layer below the ectoderm. There is no distinct separation of a median plate or tube in the formation of the lower layer. The anterior end of the germ band becomes widened out to form the cephalic lobes (Fig. 49). The germ band is strongly flexed just posterior to the cephalic region, so that the cephalic and thoracic regions and are nearly in apposition. On the dorsal side of the expanded germ there is formed quite early a slight invagination which marks the beginning of the stomodæum. The proctodæum is usually formed a little later than the stomodæum.

Even before the formation of the lower layer is entirely completed the germ band begins to show traces of segmentation in the thoracic and anterior abdominal regions. Very soon after the segmentation of the germ band becomes apparent, the first rudiments of the appendages begin to make their appearance. The rudiments of the antennae arise first, being situated on the cephalic lobes just posterior to the region of the stomodæum. The rudiments of the mouth parts and of the thoracic limbs appear simultaneously, and those of the abdomen appear successively, from before backward, at a little later stage. The abdominal rudiments have the form of little conical projections on the ventral surface of the abdomen. They persist for a short time only and, with the exception of perhaps the two posterior pairs, leave no traces of themselves when they are absorbed.

Tracheal invaginations begin to appear at about the same time as the limb rudiments. Eleven pairs of invaginations are formed;—a pair on each thoracic segment and a pair on each of the first eight abdominal segments. These invaginations, with the exception of those on the thorax and on the eighth abdominal segment, disappear during embryonic life. The four that persist form the external openings of the tracheal system of the larva.

The nervous system begins to appear simultaneously with the tracheal system and the abdominal limb rudiments. The brain is formed in the cephalic lobes as paired thickenings of the ectoderm just anterior to the stomodæum. The ventral chain of ganglia are formed as ectodermal thickenings, a pair to each

segment. Those of the four posterior abdominal segments are very small and do not continue to develop.

In the later life of the embryo there is a marked concentration of the ventral nervous system. The ganglia in the abdominal region are reduced to a nerve cord and the ganglionic part of the chain is confined to the thorax. When the lower layer was formed, two masses of cells, one anterior and the other posterior, developed in a manner distinct from that of the great mass of the lower layer. These two cell masses become the rudiments of the developing enteron. As the growth of the embryo goes on they spread farther and farther toward the center of the body forming two u-shaped bands of tissue. Finally the two bands come together and fuse on the ventral side, the dorsal side remaining open until after rotation takes place. While the changes leading to the establishment of these sets of organs are going on, the germ band is increasing rapidly in size, both longitudinally and laterally. The posterior end of the embryo becomes strongly flexed, so that it extends toward the posterior end of the egg and lies along the ventral side of the abdomen. The appendages have increased in length and the mandibles and maxillæ have become lobed.

On the fourth or fifth day after the egg is laid, rotation of the embryo takes place. The amnion and serosa fuse at the point where they previously separated. The fused envelopes are ruptured and the embryo begins to be drawn out through the opening in the membranes. The head of the embryo passes anteriorly along the ventral surface of the egg until it comes to occupy the anterior end of the egg, the posterior part of the embryo taking up its position in the posterior end. By this rotation the embryo has come to a position so that its ventral surface is next to the ventral surface of the egg. The embryonic envelopes, during the process of rotation, are carried around so that they lie as a shrunken mass on the dorsal side of the embryo, making a provisional body wall. The serosal part of the envelope soon becomes a thick mass of cells, with prominent nuclei, situated just posterior to the head, making the dorsal organ. The yolk mass of the egg, which by this time has been much diminished in bulk, is brought so that it lies inside of the body in the region of the growing enteron. The dorsal walls of the enteron now grow rapidly and soon inclose

the yolk substance within the lumen of the gut. The dorsal organ begins to break up, its cells disintegrate, their substance being used for the nourishment of the embryo. The body walls of the embryo grow out laterally and take the place of the amnion as the covering of the dorsal surface. After the dorsal wall of the enteron has closed, a pair of diverticula are given off from it near the anterior end. These increase rapidly in size until they are larger than the original part of the enteron.

Quite late in the embryonic life of the insect there are formed in the thoracic region of the embryo five pairs of imaginal discs, three pairs on the ventral and two pairs on the dorsal side. These discs arise as ingrowths of the hypodermis which soon lose their connection with the outer layer and remain just below the surface as closed pouches of ectoderm. The internal layer of the pouches increases in thickness by the multiplication of the cells, but the outer part remains a single celled layer.

In the latter part of the embryonic development the changes which take place are mostly confined to the readjustment of the organs already present, which gives to the fully formed embryo the proportions seen in the newly hatched larva. These changes are particularly noticeable in the appendages. The larval integument is secreted by the hypodermis. There is an increase in the size of the embryo so great that the egg is distended until it is markedly larger than at the time it was deposited.

On the thirteenth or fourteenth day after the egg is laid the shell splits on the anterior end and the larva appears. The larva when it first comes from the egg is rounded and compressed on account of its having had to conform to the shape of the egg shell. After it is free it soon flattens out and assumes the typical larval form. The larva moves about for a short time after hatching and then settles down to its scale-like immovable existence. After its period of moving is over the legs begin to atrophy and by the time the pupal stage is reached have almost completely disappeared. The mouth parts of the larva consist of a number of piercing setæ which are thrust into the tissues of the leaf, where they remain during the larval stage. The tracheal system shows peculiar adaption to the mode of life which the larva assumes. The body of the larva is in close contact with the surface of the leaf, so that no air could reach it from that

direction. Two special channels for conveying the air to the spiracles, which are situated on the ventral surface of the body, have been developed. These breathing folds are grooves in the integument of the ventral side, one in the thoracic region, the other on the posterior part of the abdomen. The cavity of the breathing folds is supplied with fine chitinous hairs and there are a number of stiffer hairs at the aperture of the fold which serve to prevent the entrance of solid particles. There are four pairs of spiracles, one abdominal and three thoracic, one pair of the latter being situated just posterior to each pair of legs. These spiracles open into a series of projections of the first breathing folds, each fold being divided into three branches at the internal end.

The tracheal system consists of a ventral trunk on either side connecting the spiracles, two dorsal girdles connecting the two anterior pairs of spiracles, and a dorsal trunk on either side extending from the anal spiracles to a point half way between the second and third thoracic spiracles, where it joins the ventral trunks. Branches are given off from the first spiracle as follows. Two main branches, one of which soon divides into a large number of long twigs which spread out to the sides of the body. The other main branch gives off the dorsal girdle, and soon after divides into two about equal branches one of which is the ventral trunk, while the other goes anteriorly. This last trunk divides into two branches, the dorsal branch breaking up into long convoluted tubes which supply the sides of the head, the other goes almost to the mouth opening, where it curves around and breaks up into a number of branches which continue anteriorly to the edge of the body. The trunks from the second pair of spiracles divide into two main branches each of which gives off smaller branches, the upper posteriorly and the lower anteriorly, to supply the surrounding viscera. The main ventral branch goes to the ventral trunk, the dorsal branch forming the dorsal girdle. The third spiracle opens into a trunk which gives rise to an external and an internal branch. The external branch soon separates into an anterior and a posterior division and each of these breaks up into a number of fine branches supplying the body in the metathoracic and anterior abdominal region. The internal branch goes to the ventral trunk. The anal spiracle gives rise to a dorsal and a ventral

branch and a smaller branch laterally. From the lateral branch there arises successively a number of twigs going to the sides of the abdomen. The ventral branch goes to the ventral longitudinal trunk and the dorsal branch to the dorsal longitudinal trunk.

In the abdominal region of the larva the rudiments of the reproductive organs appear as a pair of prominent yellowish organs made up of large cells. The imaginal discs of the external genital organs appear during the larval period as two pairs of invaginations of the hypodermis at the posterior part of the abdomen. The imaginal discs of the hypodermis appear in the abdomen at about the same time as those of the genital organs.

There are three moults during the larval stage. The first one occurs at from five to six days after hatching. The second occurs four or five days later, and the third five to six days after the second. At each of the moults there is a very appreciable increase in the size of the larva, but there is no apparent change other than the growth of the organs and the formation of the imaginal discs already mentioned, although it is probable that the imaginal discs of the digestive and other organs are formed during larval life. With the occurrence of each moult there is an increase in the number of the wax rods secreted around the margin of the body.

In the pupal stage (Fig. 43) which lasts from twelve to sixteen days, there are many important changes taking place on the interior. The whole external form of the insect is changed, from that of a wingless, motionless larva, to an active flying form. The greater part of the organs of the larva, with the exception of the nervous and reproductive systems, are entirely made over to met the requirements of the new mode of life. All of the muscles are reduced to an almost structureless condition. The greater part of the muscles of the body undergo histolysis at the same time. The imaginal discs of the thoracic region become everted so that they lie outside of the body. The developing legs take on their normal appearance, the wings are folded up in the form of pads on the thoracic tergites. The external genital organs are developed from the two pairs of imaginal discs in the posterior parts of the abdomen. The central part of the nervous system passes directly over from the larva to the imago, but it undergoes farther concentration during the pupal period.

The reproductive organs pass over from the undifferentiated state, and begin to show the characteristics of the male or female organs. The genital ducts, connecting the reproductive organs with the exterior, develop. The larval hypodermis is broken up and the body wall of the adult is formed from the imaginal discs present. The imaginal integument is apparently formed as a secretion from the hypodermis. The escape of the imago from the pupa case is accomplished by the splitting of the case in the mid dorsal line from the anterior end to the region of the thorax.

THE ADULT INSECT.

The adult insect (Fig. 46 and 51) measures 1 to 1.5 millimeters from the head to the end of the folded wings. The males are as a rule smaller than the females, and have more slender bodies. The body is yellowish in color. The wings are pure white and each has a single median vein, which in the fore wings has a branch near the base. The legs are long and slender, and are terminated by a two-jointed tarsus which is furnished with three claws. The eyes are four in number, those on each side of the head situated one above the other with a triangular piece of integument extending between them from the posterior side of the head. Above each eye is an ocellus.

The mouth parts consist of a three-jointed rostrum which arises from the back side of the head, and contains on its anterior side a groove in which are situated four piercing setæ. The setæ have a different point of origin from the rostrum, arising farther forward on the head. The antennæ are seven jointed. The first two segments are short and stout, the remaining five rather long and slender and covered with ring-like markings. The thorax is very deep and its segments short. The thorax and abdomen are connected by a narrow prolongation of the metathorax.

Digestive System. See Fig. 51. The pharnyx, situated at the base of the rostrum, is a narrow tube hardly to be distinguished from the œsophagus, into which it passes with very little change in size. The œsophagus is a long narrow tube extending from the pharynx to the metathorax where it joins the mid-intestine. The mid-intestine runs back to the anterior part of the abdomen where the pair of large diverticula are given off.

From this point it passes posteriorly to the sixth abdominal segment where it turns and runs anteriorly again to the first abdominal segment; here it turns about again and joins the hind-intestine which runs posteriorly to open on the dorsal surface of the eighth abdominal segment at the vasiform orifice. The salivary glands are small, nearly spherical organs, located in the dorsal part of the prothorax. They are made up of a small number of large secreting cells. Coming from each gland is a small duct which unites with its fellow just posterior to the brain in the median line.

Muscular System. See Fig. 51. The muscles of the body are arranged in three chief systems. First: the intersegmental muscles running between the segments for the whole length of the body. These muscles are attached to the folds of the integument at the joints between the segments. Second: the muscles of the wings, which are arranged in two sets, the elevators and the depressors. The elevators are attached at their ventral ends to ridges on the integument of the ventral wall of the two posterior thoracic segments, and at their dorsal ends to the wings. The depressors of the wings are two large muscles situated in the dorsal part of the thorax, attached to the lateral and dorsal walls of the thorax, and to a deep median ventral prolongation of the dorsal integument of the thorax. Third: the muscles of the legs. These muscles are in part attached at the dorsal ends to the dorsal wall of their respective segments, and in part to the ventral median ridge. The ventral ends of both sets of muscles are inserted in the walls of the femur of the leg to which they are attached. There is a small set of muscles for moving the mouth parts, which are attached dorsally to the dorsal and lateral walls of the head and prothorax. In the posterior end of the abdomen there is a set of small muscles which move the ovipositor.

Nervous System. See Fig. 51. The nervous system is very much concentrated. It consists of the brain and a ventral ganglionic mass. The brain is quite complicated although of rather small size. The *cerebral hemispheres* are very prominent, standing above the other positions of the brain. The optic lobes are small, hidden beneath the cerebal portion of the brain. The optic tracts are well developed. They appear as a pair of

rounded bodies just posterior to the cerebral hemispheres. The ventral nerve chain consists of a ganglionic mass separated into two parts by a narrow constriction. The anterior mass is small and closely united with the brain, the circum-œsophageal commissures being very broad and the aperture through which the œsophagus passes far back. The second ventral ganglion is large and lies entirely within the mesothorax. It gives off the nerves to the all the legs, and smaller branches to the organs of the thorax. Structurely it is for the most part made up of nerve cells, the amount of fibres being comparatively small. From the posterior end of the second ventral ganglion a large nerve cord passes posteriorly to the abdomen, giving off nerves to the organs in each of the segments through which it passes. It breaks up into a number of fibres in the seventh abdominal segment, the resulting fibres supplying the two posterior segments of the abdomen.

Reproductive System. The reproductive system of the female insect (Fig. 51) consists of two ovaries, each made up of five chambered ovarian tubes. The ovaries are large, extending from the eighth abdominal segment to the anterior part of the abdomen, filling the greater part of the abdominal cavity. The vagina occupies the posterior part of the seventh and the whole of the eighth abdominal segments. The seminal receptacle is situated on the ventral side of the vagina in the eighth segment. The oviduct opens to the exterior at the posterior end of the abdomen between the valves of the ovipositor. The ovipositor, is short, made up of two valves which are deeply concave on the inner side.

The male reproductive organs (Fig. 50) consist of the testes, two rounded bodies situated dorsally in the fifth abdominal segment, one on either side. Coming from the testes the vasa deferentia make a complete turn and are then enlarged to form the seminal vesicles. The two vasa deferentia unite in the seventh segment to form a single tube which extends to the end of the abdomen. At the point where the two vasa deferentia are united they are joined by the ducts from the two large accessory glands. The external genitals of the male consists of the penis and a pair of well developed claspers.

Respiratory System. The respiratory system of the adult insect corresponds in arrangement very closely to that of the

larva. There are four pairs of stigmata, three on the thoracic region and one on the eighth abdominal segment. The stigmata of each side are connected by a ventral trunk, but the dorsal girdles are not complete. The dorsal longitudinal trunk is not complete in the imago, but long branches extend anteriorly from the anal spiracles, and posteriorly from the thoracic spiracles, on the dorsal side of the body.

REMEDIES.

The experience at this Station in destroying the plant-house Aleyrodes is similar to that at the Connecticut Station and the following from their report* will serve to express the situation here.

"Spraying.—In 1895 the writer (Mr. W. E. Britton) used whale-oil soap solution (1 pound of soap to 5 gallons of water) in the form of a spray on the under surface of the leaves to kill the nymphs. The result was successful, but on account of the disagreeable odor of whale-oil soap, it was discarded. Fir-tree oil (one-half pint in 2 gallons of water) gave excellent results when the plants were thoroughly sprayed with the solution. The adults and nymphs which were moistened by the spray were killed. The cost of the material, however, makes the treatment an expensive one and precludes its use on a large scale. Fir-tree oil has a pleasant odor and is not objectionable to use in a green-house of ornamental plants or even in a dwelling.

"A fine spray of kerosene and water (15 per cent. kerosene) was then applied to the tomato plants on sunny days, by means of a 'kerowater' pump, with good results in killing the insects. But kerosene, like whale-oil soap, has an unpleasant odor, and occasionally causes a slight injury to the foliage. Even when not at first apparent, the leaves in some instances took on later a brown or reddish color not indicative of health, and some of these finally dropped.

"Early in 1901, we began spraying the tomato plants with common soap and water, dissolving one pound of soap in eight gallons of water. This seemed to be best, all things considered, of any of the sprays. Not only was it effectual in killing all adults and nymphs with which it came in contact, but it was

*Report of the Connecticut Agricultural Experiment Station for 1902.

both inexpensive and inodorous, and at first did not appear to cause the slightest injury to the plants. The soap was cut in thin slices, then dissolved in hot water, and cold water added to make the right proportions. The plants received one application each week for about three months, when some of the leaves finally exhibited signs of injury.

"As the plants had never been sprinkled with water from the hose and had received frequent applications of soap, the leaves finally became coated over with soap to such an extent as to interfere seriously with the normal processes of respiration. The lower leaves in some cases shriveled and dropped. A few sprayings cause no injury, and probably none would be done in any case if the plants are sprinkled freely with water to remove the excess of soap.

"The chief difficulty with sprays of any kind is that it is impossible to reach all places where the insects are located. Many leaves are curled so that the spray cannot reach the under side, and there are always portions of the plants which do not, on account of location perhaps, receive a thorough treatment; this permits the escape of a sufficient number of adults, or of nymphs which soon change to adults, to keep the house infected.

"Fumigating.—Fumigating with tobacco is the remedy that has been oftenest recommended for this insect, but the fumes from the burning of ordinary stems or dust do not kill any considerable number of the insects. Many are stupefied by the fumes and fall from the plants, but revive later and soon become as active as ever. During the past two or three years tobacco used in this way seems to have been less effective in destroying the adults than when the writer first employed it eight years ago. Where the adults are stupefied and fall to the ground a copious watering of the surface of the soil will kill them in great numbers."

At this Station fumigation with hydrocyanic acid gas is the most successful remedy tried. The gas was made with a half more strong sulphuric acid (liquid measure) than the weight of cyanide, and a half more water than acid. The jar containing the dilute acid was placed on the floor of the house, and the cyanide of potassium which had been put into a paper bag, weighed, and suspended over the jar, was dropped into the acid. This treatment is in accordance with the suggestions by John-

son*. The house was then closed and left, in various experiments, from forty-five minutes to fourteen hours. When the fumigation was given early in the afternoon of a bright day, the tomato plants were injured by the use of one ounce cyanide to 1000 cu. ft. of space. The same amount caused no trouble, however, when the fumigation was postponed until evening, a fact which verifies Johnson's statement†. With 1 oz. cyanide to 1500 cu. ft. of space the plants were not injured. In no case, however, is it considered advisable to fumigate when the sun is shining brightly, or when the temperature is above sixty degrees.

*Johnson, fumigation methods, pages 9 and 118.
†Ibid, 145.

EXPLANATION OF FIGURES.

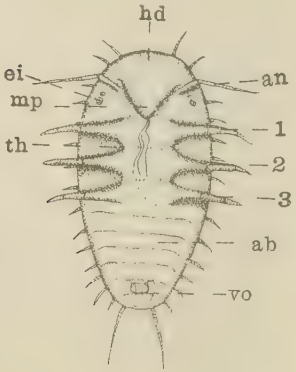
Fig. 41. Egg. x130.
Fig. 42. Newly hatched larva from the ventral side. x130.
Fig. 43. Pupa from the dorsal side. x130.
Fig. 44. Longitudinal section of a mature egg in the ovary of the female. x530.
Fig. 45. Longitudinal section of an egg when the invagination of the germ band has begun. x530.
Fig. 46. Adult female from the left side. x130.
Fig. 47. Side view of egg with embryo, just before closure of amnionic cavity.
Fig. 48. Reconstruction of a fully developed embryo just before hatching.
Fig. 49. Ventral view of the germ band after segmentation has begun. x530.
Fig. 50. Male reproductive organs seen from above. x130.
Fig. 51. Reconstruction of an adult female shown with the dorsal part of the body wall removed. x130.

REFERENCE LETTERS AND NUMBERS.

a	anterior.
ab	abdomen.
abp	abdominal portion of germ band.
acg	accessory glands.
am	amnion.
amc	amnionic cavity.
an	antenna.
bl	blastoderm.
br	brain.
c	cephalic end of germ band.
cl	cephalic lobes.
cae	diverticulæ of mid intestine.
d	dorsal.
ei	eye.
fw	fore wing.
hd	head.
hi	hind intestine.
hw	hind wings.
idro	rudiments of reproductive organs.
idw1	imaginal disc of fore wing.
idw2	imaginal disc of hind wing.
ism	intersegmental muscles.
lm	muscles of the legs.
mc	male claspers.
mi	mid intestine.
mp	mouth parts.
msth	mesothorax.
mtth	metathorax.
myc	micropyle.
nl	nerves of the legs.
nu	nucleus.
oes	œsophagus.
ov	ovary.
ovd	oviduct.
ovp	ovipositor.
p	posterior.
pas	posterior abdominal segment.
pb	polar bodies.
pe	penis.
prth	prothorax.
sd	duct of salivary gland.
se	serosa.
sg	salivary glands.
stk	stalk of egg.
te	testis.
th	thorax.
v	ventral.
vd	vas deferens.
vg	ventral ganglia.
vg 1	first ventral ganglion.
vg 2	second ventral ganglion.
vg 3	third ventral ganglion.
vnc	ventral nerve cord.
vo	vasiform orifice.
wm	wing muscles.
yk	yolk.
1	fore leg.
2	middle leg.
3	hind leg.

Figure 41.

Figure 42.



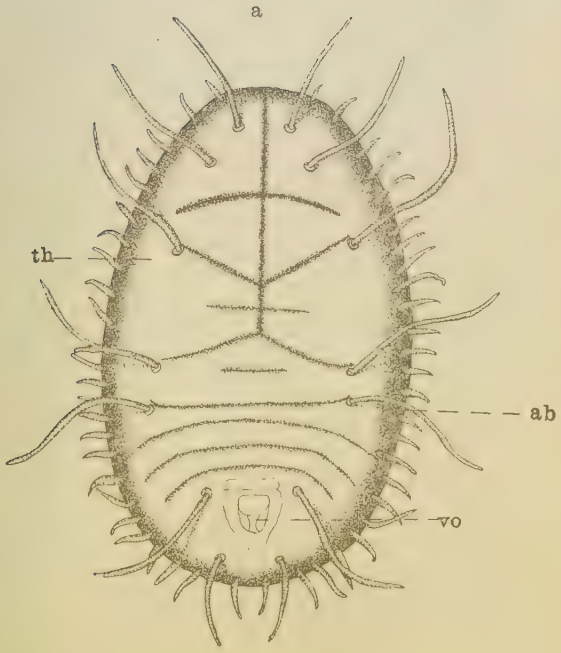


Figure 43.

Figure 44.

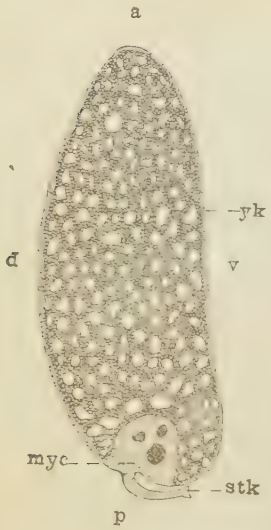
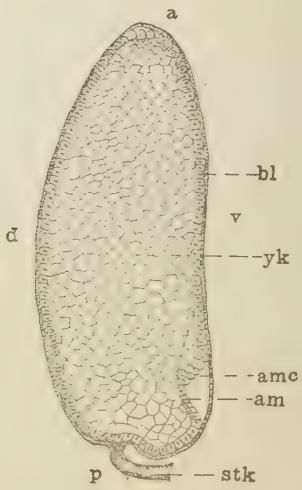


Figure 45.



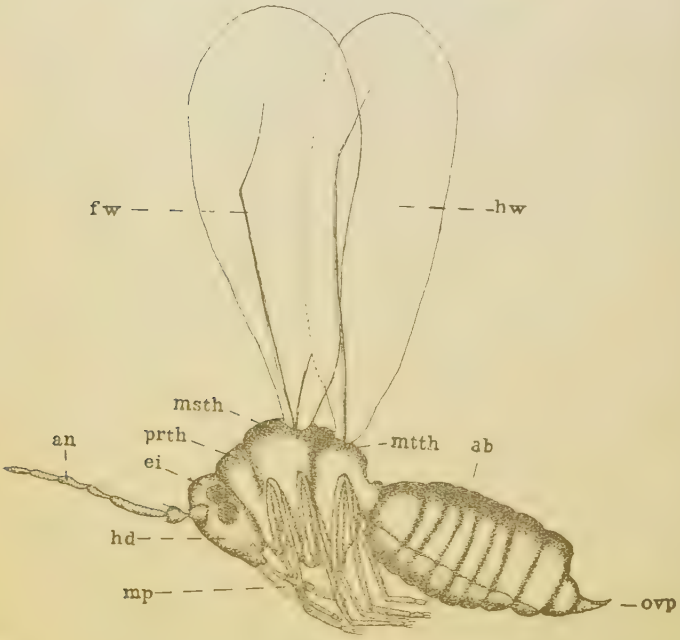


Figure 46.

Figure 47.

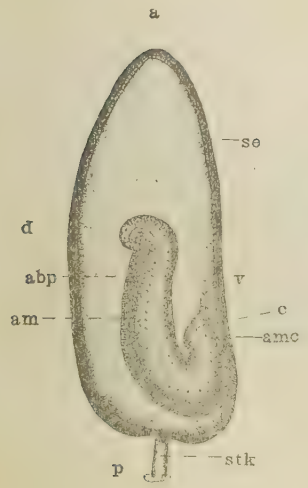
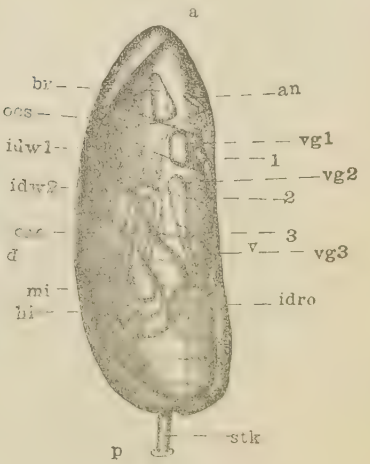


Figure 48.



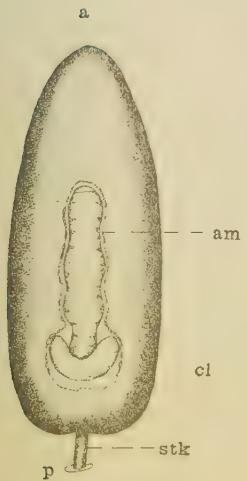


Figure 49.

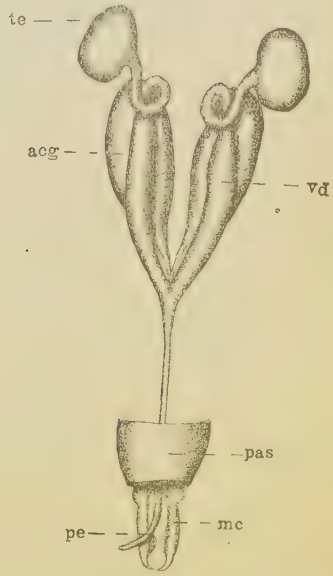


Figure 50.

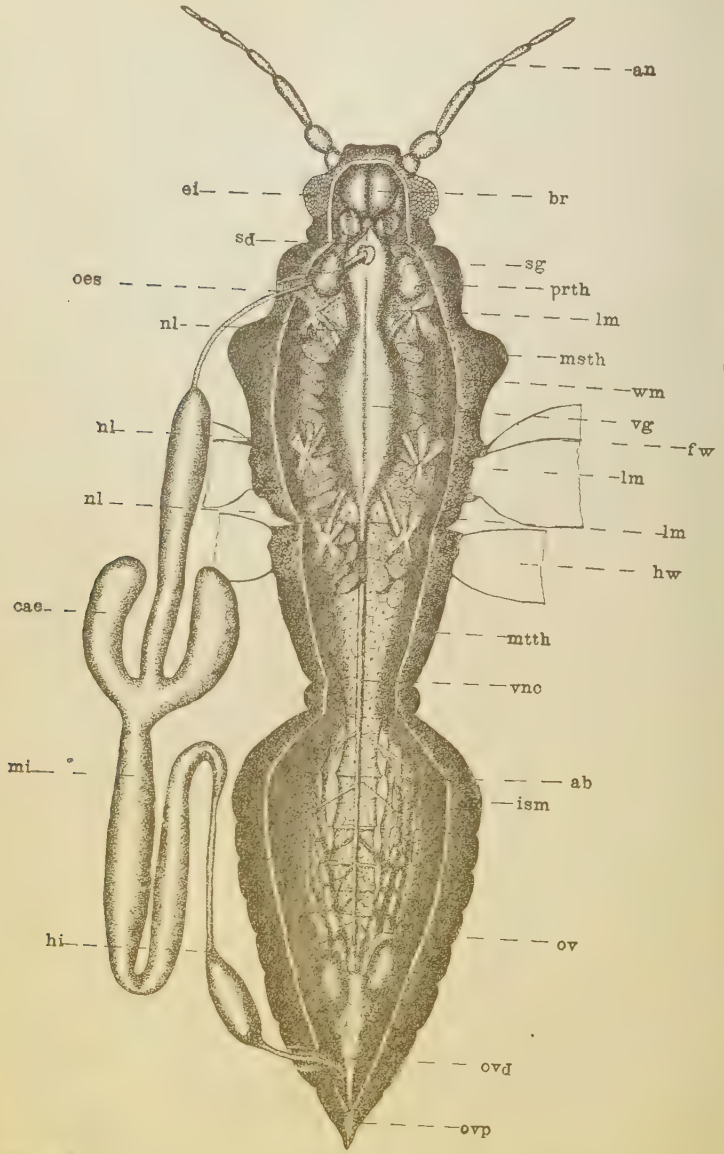

an
br
ei
sd
sg
oes
prth
nl
lm
msth
wm
nl
vg
fw
lm
nl
lm
hw
cae
mtth
vnc
mi
ab
ism
hi
ov
ovd
ovp

Figure 51.

BROWN-TAIL MOTH AND OTHER ORCHARD MOTHS.*

EDITH M. PATCH.

It is not the well kept orchard that will serve as a shelter and breeding place for any serious pest. It is the apple tree down the lane, too old and decrepit to yield fruit, but still able to put forth leaves enough for a spring crop of bud moths and tent caterpillars, or a summer brood or two of tussock moths. It is the group of old pear trees, apparently owned by no one, with their branches hung with undersized pears cracked to the centre with scab disease, and later, when their fungus-mottled leaves fall, festooned with nests of the brown-tail moth. It is the wild cherry bushes in the back ground that show in the winter for the menace they are, when they are seen to be distorted with black knot and hung with old caterpillar webs and tents, besides being decorated by brown egg rings and white egg clusters in provision for next season's caterpillars. It is the deserted or neglected trees that are to be feared, for in them many species of caterpillars dangerous to the orchard trees breed unnoticed, perhaps for years, until they become numerous enough to make conspicuous ravages. Then one orchardist cries, "It isn't much use to try to raise apples with a new sort of caterpillar creeping in every year," and another says, "The fact is, it doesn't seem reasonable to expect a clean orchard with twenty or thirty pests lurking in the outskirts," and turns his attention to neighboring breeding places as well as to his orchard, and markets his crop in spite of the "new pest."

* Paper from the Maine agricultural Experiment Station, Entomology No. 22.

Brown-Tail Moth. *Euproctis Chrysorrhœa.*

History (1734-1904).

European laws have been in force for one hundred and seventy years requiring land owners to destroy the winter nests of the brown-tail moths found on their trees, and this moth was described as a common pest in the earliest works on orchard insects.

About seven years ago the first outbreak of this pest occurred in Somerville and Cambridge, Massachusetts, the centre of the infested region being a florist's establishment where large numbers of shrubs had been imported from France and Holland. It is thought that the brown-tail moth was accidentally introduced upon some of these foreign plants and had become established in the vicinity before it was noticed.

Since 1899 this insect has been introduced,—probably repeatedly,—into Southern New Hampshire, where the infestation is now extended enough to cause alarm.

Five years ago the moths were captured on Cutts Island, Kittery Point* and the same season the caterpillars were reported from South Berwick where they were supposed to have been imported on rose bushes from Somerville, Mass. The colony at South Berwick was evidently destroyed and the moths on Cutts Island did not at this time continue to breed.

Late in March, 1904, Kittery was found to be badly infested, the winter nests being common in the pear trees in the village, while a few were located in wild cherry fringe on Badger's Island. Many of these winter nests were gathered and burned by the owners of infested trees and those that remained were destroyed by an expert under the direction of the State Commissioner of Agriculture, so that the ravages of the caterpillars were effectually prevented for this season.

Unfortunately, however, last July, during the time when the moths were on the wing, strong southwesterly winds occurred and the insects are reported to have appeared in great numbers

---

*Maine Agr. Exp. Sta. Bul. No. 61, pp. 36-39.

NOTE. The account of this insect is written with reference to Mass. Crop Report, Vol. 17, No. 3; Mass. State Board of Agriculture, Bulletin of information, The Brown-tail Moth 1898; New Hampshire College, Agr. Exp. Sta., Bul. 107; Me. Agr. Exp. Sta., Bul. No. 61. It is also a record of observations made this season at Kittery.

in Portsmouth and Kittery, the electric lights about the navy yards being the centre of attraction on the Maine side of the river.

While many of the moths were killed, without doubt enough escaped to distribute eggs all about that vicinity, and though the young caterpillars do practically no harm in the fall, there is every reason to believe that they will be present in alarming numbers another spring, unless the winter nests are removed as they were last season. Such a wholesale immigration of winged forms might never happen again, but while there is a chance of its occurring any summer, and an almost certain danger of small and less conspicuous immigrations, it is well to understand the situation and conditions about Kittery, especially in view of making it less vulnerable to orchard pests.

DESCRIPTION AND HABITS.

The moths. (Figure 27.) The moths, expanding from one and one-fourth to one and three-fourths inches, are white except for the abdomen, which is tinged with brown and tipped with a tuft of brown hairs. This tuft is small and dark in the male, but the large golden-brown tuft in the female is conspicuous enough to be the most striking characteristic of the moth, and has won for this insect its descriptive name of "brown-tail." These moths are on the wing in July, and unlike some closely related pests,* the brown-tail females as well as the males are strong fliers. They are active at night and as bright lights have an attraction for them they sometimes fly a long way toward a lighted district.

The eggs. The female usually selects a leaf near the tip of the branch, on which to deposit from one hundred and fifty to three hundred eggs. Some of the brown hairs from the abdominal tuft adhere to the egg-mass and give it the appearance of a brown felt lump. While the moths have a preference for pear trees, wild cherry, apple, and white oak prove very attractive and other trees are not scorned.

The caterpillars in the fall. By the middle of August most of the eggs are hatched and the young caterpillars spin a slight

*The weak-winged female gypsy moth and the wingless females of certain tussock moths.

web over the leaf near the egg cluster. From this protection they advance side by side, sometimes two hundred tiny caterpillars feeding in an unbroken line, though they huddle together beneath the web when disturbed in any way. When they have eaten all but the skeleton of the first leaf, they draw another into the web and repeat the process at intervals during the late summer. They feed slowly, however, and spend so much time spinning their web that they do comparatively little damage to the trees in fall, and they are still very small when cold weather comes on, those removed from the winter nests being only about one-fourth of an inch in length.

The winter nests. (Figure 19.) In the fall the young caterpillars weave additional layers of silk about their retreat, fastening it securely to the branch by the web, and pass the winter thus in colonies of one hundred and fifty to three hundred. These nests, which look like a cluster of dead leaves hanging from the branches, are readily seen after the other leaves have fallen. This is a very unusual yet most commendable habit in a caterpillar pest, for they can be killed, hundreds at a time, simply by destroying the nests in which the colonies hibernate.

The caterpillars in the spring. Early in the spring the young caterpillars emerge from their winter nests and feed upon the opening leaf buds. Until about the middle of June they feed greedily upon the leaves, completely stripping the trees where they are numerous.

When full grown the caterpillars are about one and one-half inches long. They are dark brown with a sprinkling of orange. Long fine reddish-brown hairs cover the body, and a row of conspicuous white hairs runs along each side. Like the caterpillars of the tussock and gypsy moths, they bear bright red eversible tubercles on the top of the sixth and seventh abdominal segments.

Poisonous qualities of the caterpillars. Were the caterpillars to be feared only for their ravages upon orchard and other trees, the situation would be alarming enough, but not less serious is the physical discomfort experienced by people living in infested districts. When the minutely barbed hairs of the caterpillar come in contact with the skin they cause an eruption similar to and in many cases worse than ivy poisoning. These hairs are

brittle and where the caterpillars are numerous few people are likely to escape, as the caterpillars drop from the branches and creep about, even entering houses. Direct contact with the insects themselves is not necessary, however, for when the caterpillars shed their skins, the molts are blown about widely scattering the barbed hairs. Thus in infested districts it is no uncommon occurrence for whole families to suffer from the rash caused by the hairs which settle upon clothes hung out to dry. Children gathering cherries are badly "poisoned," and near Everett, Mass., people have been obliged to leave their homes for uninfested places in order to recover from attacks of the "caterpillar itch."

"So severe is this affection that in many cases people have been made seriously ill by it. The best remedy for it is the liberal use of cooling lotions, or, what is more satisfactory, even if less pleasant, the free use of common vaseline." *

The cocoon. The caterpillars are usually full grown in June. They then spin loose cocoons, attached commonly to leaves, though sometimes other shelter is sought. Within these they transform to brown pupæ about three-fourths of an inch long. From the first to the twentieth of July the moths with pure white wings and brown-tipped abdomens emerge from these cocoons to deposit eggs for the next generation of troublesome caterpillars.

Manner of Distribution.

New localities may become infested in various ways. When startled, the caterpillars have a habit of letting themselves down from the branch and hanging by a frail silken thread. They may so swing against the clothing of a person, or drop upon a passing car or wagon and be carried long distances.

Egg laden moths may be attracted to the lights in trains and electric cars and be borne into uninfested localities before they flutter off to deposit their eggs. In New Hampshire the new localities were generally found along the lines of cars coming from badly infested regions.†

* Mass. Crop Report, Vol. 17, No. 3, p. 39.
† N. H. College Agr. Exp. Sta. Bul. 107, p. 59.

"A reliable observer, Mr. A. M. Cobb, Malden, Mass., reports that when the Bangor boat of the Eastern Steamship Line was passing some miles off Marblehead, early in July, 1904, a large swarm of the brown-tail moths came aboard and completely covered parts of the vessel." * Dr. James Fletcher, entomologist, Central Experiment Farms, Ottawa, Can., reports that a single specimen of the brown-tail moth was taken at St. John, N. B., in the summer of 1902. Such occurrences suggest the advisability of watching each fall the ports along this line for winter nests.

About the middle of July, 1904, the morning after a strong southwesterly wind, the telegraph poles and the sides of some of the buildings near the Kittery Navy Yards were reported to be white with the white-winged brown-tail moths. The town was alarmed and great numbers of the moths were washed down with hose and destroyed, but that many escaped and deposited eggs, the neighboring trees (especially the pears and wild cherries) bear abundant evidence.

Thus strong winds, lighted trains and boats, and vehicles of all sorts are seen to be among the factors which hasten the natural spread of this dreaded pest.

REMEDIAL MEASURES, DIRECT AND INDIRECT.

Destruction of certain breeding places.

The vicinity of Kittery, the entering point for the pest in Maine, is overgrown with wild cherry tangles, caterpillar-haunted † and distorted with black-knot fungus. Old and worthless trees, either fruitless or bearing scabby pears and apples, straggle neglected along the lanes and hang half dead branches over every wall. Inasmuch as such trees are a menace to the orchard interests of York county and to the State, it is desirable that they be cut down and burned. Some large and carefully tended orchards (one near Elliott yielded 1,300 barrels in 1902) which are within ten miles of the infested district should be protected against needless risks.

* Mass. Crop Report, Vol. 17, No. 3, p. 38.

† Among the most destructive being the tent caterpillar, two species of tussock moths, the fall web worm and the brown-tail moth.

The argument for such destruction is four-fold. It is in just these trees that the winter nests would longest escape detection, it being especially difficult in a dense growth of wild cherry to ascertain whether every dangling dried leaf is attached to a winter nest. The fruit trees in question being already worse than useless, it would mean apparently a needless yearly tax, either locally or upon the State, to keep them free from brown-tail moths. There will remain enough trees worthy this attention. This remedy, though indirect, would lessen the labor of direct search for and destruction of winter nests over this ground, if not for always, yet for many years to come. Since the infested area is still comparatively small, the cost of the cutting and burning ought not to be great.

Cutting and burning the winter nests.

This is the most important of the direct remedies because it is the easiest, cheapest, and, if thoroughly done, a sufficient protection against the ravages of this pest. The webs and leaves that compose the nest are woven tightly to the tips of the branches and hang there like dead leaves all winter. With so many months for inspection there is no excuse for harboring the hibernating caterpillars on shade or orchard trees. After they are cut from the branches, the nests should be burned, as this is the simplest way of destroying the colony within.

"As showing how cheaply webs may be gathered where a general campaign is made the figures of work done by employees of gypsy moth committee in 1899 are of interest. At that time over nine hundred thousand webs were destroyed at the total outlay of nine thousand seven hundred dollars." * This would mean, accounting for the variation in the number of the caterpillars per nest, the destruction of from 15,000 to 30,000 caterpillars for each dollar's outlay.

A bounty put upon the winter nests.

Last winter in Portsmouth, N. H., the City Improvement Society placed $50 with the superintendent of schools, who paid five cents a dozen for winter nests. Hundreds of nests were brought in by the children and burned in the school furnace. In March groups of Portsmouth newsboys were to be seen scanning the branches overhead and darting off eagerly for

* Mass. Crop Report, Vol. 17, No. 3, p. 39.

"brown-tail nests." In reply to a question one bright-eyed youngster stopped long enough to say, "O we cleaned 'em all out on ——— street and then we came down here." About the same time a Kittery urchin was heard to remark somewhat wistfully, "The Portsmouth kids are makin' their fortune pickin' brown-tails."

Instruction in public schools.

It would be a simple matter to teach in an elementary way a few things about the important insects in the vicinity. A little observation and a little reading would prepare any teacher to do this. A single lesson would enable a child to distinguish the winter nest of the brown-tail moth from the webs of the fall web worm and tent caterpillar or from the various cocoons which are attached to leaves. All these things are brought into Kittery with the question "Is this the brown-tail nest?" and the fact that many people within the infested district do not know what to look for suggests the need for preparing the children of Maine to watch intelligently suspected areas for the occurrence of this pest. If nothing else were accomplished, it would be worth while to have every child know at least that the insects are not "just bugs that happen to be around," but forces of vital importance both for good and for evil in the agricultural interest of his state and nation. It seems rather a pity to leave a few such things as the relation of the white grub to the May beetle or the bumblebee to red clover, mysteries to be solved in a college course.

Spraying.

The caterpillars are readily killed by arsenical sprays. This remedy is most effective when applied as soon as the leaves develop in the spring. Of course where the winter nests have been destroyed there will be no need of this remedy and it is much easier to kill about two hundred caterpillars enclosed in a nest than to wait until they are scattered over the tree.

State Legislation.

Every state needs a statute enabling authorities to treat as common nuisances neglected property which is infested by dangerous fungus diseases or insect pests; and state appropriations should be sufficient to control conditions which are of more than local importance.

"The habit of the caterpillar in wintering over in webs at the tips of the leaves gives a key to the simplest and cheapest remedy, which is merely to cut off and burn webs during the fall, winter or spring. This preventive means is most effective, and gives such excellent results that in Germany, France and Belgium there is a law making it obligatory on property owners to destroy the webs during the winter season. Where citizens neglect to carry out this work it is done for them, and the sum thus expended added to their tax levy." *

THE GYPSY MOTH. *Porthetria dispar.* A FOREWORD.

The gypsy moth has not yet been found in Maine. The entrance of this pest, however, is probably only a matter of time. Unlike the brown-tail moth, the female gypsy moth is weak-winged and is thus unable to deposit eggs far from the cocoon from which she emerges. It is due to this in part that this moth has not yet found its way here, for it has been in eastern Massachusetts for thirty-six years and its ravages for the past sixteen years are well known.

In a district badly infested by the caterpillars of the gypsy moth no garden vegetable except the onion is safe; flowers and grass are eaten, and practically all fruit and forest trees are defoliated, pines and other coniferous trees dying as the result of a single stripping and deciduous trees not being able to withstand a three years' attack.

There is no such simple and comparatively inexpensive means of combating the gypsy moths as with the brown-tail moth, for they do not hang their colonies in plain sight all winter, but pass this season in the less conspicuous egg stage, the egg clusters being hidden in any crevice the infested area offers. These caterpillars are more resistant to poison sprays than those of the brown-tail moth and the problem is in many ways more difficult. It is the wise man who looks ahead and an additional argument for clearing out the growths which are already overrun with orchard caterpillars, (the brown-tail moth among them), is presented by the fact that southwestern Maine is the point where the first infestation of the gypsy moth would naturally occur. Nothing by way of watchfulness, instruction or

* Mass. Crop Report, Vol. 17, No. 3, p. 39.

provisional care that can be done to guard the State against these twin pests should be neglected.

"The gradual spread of the gypsy moth up to the caterpillar plague of 1888-89 is a matter of record. Equally well known is the work of the gypsy moth committee of the Massachusetts Board of Agriculture, which finally succeeded in reducing the numbers of the insect to a minimum and thoroughly controlling the pest. Since the abandonment of the state work in the early part of the year 1900, the moth has had ample opportunity to increase to a point where it is' to-day more numerous, and occupying a larger area in this state, than ever before.

"Both the gypsy and brown-tail moths can be controlled by a thorough campaign over the infested municipalities. The work of the former gypsy moth committee has shown that the damage and annoyance from these pests can be practically eliminated by the application of thorough remedial measures over the entire infested districts. It is greatly to be hoped that some effort to systematically control the spread of these pests may be instituted to the end that property owners may be spared the annual visitation of the caterpillar scourge." *

Orchard Caterpillars in Wild Cherry.

In March, 1904, a wild cherry growth, just outside the district infested by the brown-tail moth, presented such strong evidence of being a common caterpillar breeding place that during the summer a few observations were made to ascertain something of the orchard pests there and whether the brown-tail moths would let another season go by without being enticed by this attractive caterpillar commonwealth. Among the insects found there, only those of importance are mentioned; and, as most of these are fully described in Apple Insects of Maine,† the general discussion is not here repeated.

ORCHARD TENT CATERPILLAR AND FOREST TENT CATERPILLAR.

Clisiocampa americana and Clisiocampa disstria.

Both these caterpillars are present. In wild growths they are commonly held in check by birds, parasites and disease. Sometimes their ravages are serious for a season or two, and a watch

* Mass. Crop Report, Vol. 17, No. 3, pp. 32 and 40.
† Me. Agr. Exp. Sta., Bul. No. 56.

has always to be kept for them in the orchard, for the colonies are large and ravenous. Orchardists are everywhere familiar with the dark brown egg-masses found upon the twigs and gather and burn them during the winter. Where these escape detection, the caterpillars can be killed in the spring by arsenical sprays. The orchard tent caterpillars construct a nest in a fork of the branches where the whole brood spends nights and cold or cloudy days. These nests, while small, are easily torn out and the colony within destroyed; or, if neglected then, the caterpillars may be killed by giving the nest a thorough soaking with kerosene early or late in the day, when the caterpillars are at home. A kerosene swab tied to a long pole is convenient for high nests. A strong alkali, whale-oil soap, or washing powder solution may be used instead of the kerosene.

FALL WEB WORM. *Hyphantria cunea.*

Another nest-building caterpillar is at present even more commonly seen in this vicinity than the tent caterpillar. Their unsightly webs are stretched in every neglected orchard and the cherry tangle is full of them. These nests are made much later in the season than those of the tent caterpillars and are easily distinguished from them, as they are looser structures and very irregular, being woven over all the leaves which the brood feeds upon. Arsenical sprays on the leaves near the nest poison the supply next to be enclosed by the web, and the caterpillars feeding upon them are killed. Sometimes, however, the webs are discovered too late in the season for poisons to be used on bearing trees. Usually the nests are so situated on the branches that while still small they can easily be removed and destroyed. Kerosene or strong alkaline applications can be made as with the tent caterpillars.

There is no need of confusing the nests of tent caterpillars or fall web worms with those of the brown-tail moth, as the greater size and looser texture of these ungainly webs are distinctive marks. Moreover, unlike those of the brown-tail moth, they contain no living caterpillars in the winter.

WHITE-MARKED TUSSOCK MOTH. *Notolophus (Orgyia) leucostigma.*

OLD TUSSOCK MOTH. *Notolophus antiqua.*

WELL-MARKED TUSSOCK MOTH. *Notolophus definita.*

The moths of this Notolophus group are closely related to the gypsy and brown-tail moths. The caterpillars resemble these two pests in having bright red tubercles on the sixth and seventh abdominal segments. The female moths are wingless and usually cling to the cocoons from which they emerge and deposit their egg clusters there. They winter in the egg stage and where they are numerous, the white, rather conspicuous egg clusters (figure 24) are gathered and burned during the winter. The caterpillars may be killed in the spring by arsenical sprays.

Caterpillars of all three species were collected in Maine this summer, the white-marked and the old tussock moths (figure 25) being common in the orchards and cherry growths at Kittery.

The white-marked tussock moth has proven a serious pest in several New England cities. For the last few years Portland has been especially troubled by them. Not long since the park board had the egg-laden cocoons gathered "by bushels" and destroyed. The same proposition faces them this year, for many of the tree trunks along the Western Promenade and vicinity are lined with this season's cocoons, the egg supply on some of the young elms being great enough to forbode defoliated trees in the spring.

HICKORY TIGER-MOTH. *Halisidota caryæ.*

This shaggy black and white caterpillar (figure 23) which grows to nearly an inch and one-half in length does not confine itself to hickory but is commonly seen late in summer feeding freely on many trees, the wild cherry and apple among them.

RED-HUMPED CATERPILLAR. *Œdemasia concinna.*

More of these have been sent to the Station this summer than any other insect. The caterpillars (figure 26) are striking in appearance having fine longitudinal stripes of black, white and

yellow; bright red heads, with a humped first abdominal segment to match; and short black spines arranged in rows. The broods are gregarious and if found while the caterpillars are young, the whole colony can frequently be removed with a small branch on which they are clustered, and destroyed. By jarring the branch they can be brought to the ground and killed there. Arsenical sprays will kill them, but as the caterpillars occur from July to October, the presence of ripe fruit often debars the use of poison.

These caterpillars were reported this season from Skowhegan, Farmington, Dexter, Eliot, Kittery, Sebago Lake, Turner, Wiscasset and Orono. Hymenopterous parasites were bred from all the specimens received from Eliot, but none of the caterpillars from the other places were attacked, although they were nearly full grown at the time they were collected.

PROMETHEA MOTH. *Callosamia promethea.*

CECROPIA MOTH. *Samia cecropia.*

These two large and beautiful moths are included, not because they seem likely to do much harm in the State, but because their cocoons, found upon trees in the winter, are frequently mistaken for the winter nests of the brown-tail moth. Figures 20, 21, and 22.

Fifty-three promethea cocoons, gathered from wild cherry and barberry bushes, were brought into Kittery last March for brown-tail moth nests. The collector, a bright little lad, was told that each contained a single brown object which would change to a large moth in the spring, and not a lot of little caterpillars such as the winter nests held. "But," he protested "I *did* open one and there was *not* just one big thing in it, but a whole lot of little ones." A second cocoon opened in his presence revealed, indeed, not a single brown pupa, but nineteen tightly packed cells, each containing the pupa of a Hymenopterous parasite. Only nine of the fifty-three cocoons yielded moths. All the rest were parasited,—twenty-two red and black Ichneumon flies emerging from a single cocoon which had been placed alone in a glass. Evidently there is no immediate danger from the promethea moth!

The cocoons of the closely related species, the cecropia moth, are frequently sent in, but the fact that they are usually accompanied by the explanation that "only one was found in the orchard," indicates that they, also, are held in check by natural enemies.

In concluding the list of orchard pests found in cherry growths in the vicinity of Kittery it may be well to state that the observations made were neither frequent nor exhaustive. Other important caterpillars, for example those of the bud moth,* might easily have grown there undetected, for the vicinity was not visited during the time they are at work.

The brown-tail moth was not found in the cherry tangle selected in March, but the succeeding generation was found to be established there in August.

Perhaps in this connection people who have sent orchard insects to the Station may be interested to know that all the living apple-leaf-eating caterpillars, which were received this season, together with what different species were found about Orono, were reared on wild cherry leaves. This was done simply as an illustration of a well known fact, and is significant only where orchards are supplied with pests from neighboring cherry growths.

Some Birds that Feed on Orchard Pests.

When a few particular species of insects become sufficiently numerous to be considered pests and artificial means for controlling them are required, the question is always suggested: How does it happen that the closely related insects just as prolific, just as ravenous, and with similar habits, do not also overrun the orchards? An answer is found in the fact that there are enough natural enemies (as birds, parasites and disease) to hold in check many insects which would otherwise call forth arsenical sprays or other artificial remedies. The fact is not always appreciated, however, that these co-workers, even where they fail to hold some particular insect in check, lessen the labor of man in his battle of spraying machines and other appliances against even the most troublesome species. The woodpecker for instance, pulls out more borers each year than man is able to destroy with knife and wire, yet this bird is not always wel-

* *Tmetocera Ocellana.*

comed to the orchard. It is purposed merely to mention here a few birds that destroy great numbers of insects, the orchard caterpillars discussed in this bulletin among them. The passages which follow are quoted from the popular and valuable Farmers' Bulletin No. 54, "Some common birds in their relation to agriculture."

"While it has long been known that birds play an important part in relation to agriculture, there seems to be a tendency to dwell on the harm they do rather than on the good. * * * The practical value of birds in controlling insect pests should be more generally recognized. It may be an easy matter to exterminate the birds in an orchard or grain field, but it is an extremely difficult one to control the insect pests. * * * If birds are protected and encouraged to nest about the farm and garden, they will do their share in destroying noxious insects. * * * A few hours spent in putting up boxes for bluebirds, martins, and wrens will prove a good investment. In many states birds are protected by law. It remains for agriculturists to see that the laws are observed.

"About 14 per cent of the quail's food for the year consists of animal matter (insects and their allies). Prominent among these are the Colorado potato beetle, the striped squash beetle, the cotton boll weevil, the chinch bug, grasshoppers, cutworms, and other pests of agriculture. * * * An examination of the stomachs of 46 black-billed cuckoos, taken during the summer months, showed the remains of 906 caterpillars, 44 beetles, 96 grasshoppers, 100 sawflies, 30 stink bugs, and 15 spiders. In all probability more individuals than these were represented, but their remains were too badly broken for recognition. Most of the caterpillars were hairy, and many of them belonged to a genus that lives in colonies and feeds on the leaves of trees, including the apple tree. One stomach was filled with larvæ of a caterpillar belonging to the same genus as the tent caterpillar, while others contained that species. * * * From two-thirds to three-fourths of the food of two common woodpeckers consists of insects, chiefly noxious. Wood-boring beetles, both adults and larvæ, are conspicuous, and with them are associated many caterpillars, mostly species that burrow into trees. * * * It is estimated that the 87 stomachs of night hawks examined contained not less than 20,000 ants; and these were not half of

the insect contents. * * * The insects that constitute the great bulk of the food of the king bird are noxious species, largely beetles—May beetles, click beetles (the larvæ of which are known as wire worms), weevils, which prey upon fruit and grain, and a host of others. * * * There is hardly a more useful species about the farm than the phœbe, and it should receive every encouragement. * * * In his insect food the crow makes amends for his sins in the rest of his dietary. * * * June bugs, and others of the same family constitute the principal food during spring and early summer, and are fed to the young in immense quantities. * * * Grasshoppers are first taken in May, but not in large numbers until August, when, as might be expected, they form the leading article of diet. This shows that the crow is no exception to the general rule that most birds subsist, to a large extent, upon grasshoppers in the month of August. * * * May is the month when the dreaded cutworm begins its deadly career, and then the meadow-lark does some of its best work. * * * Observation both in the field and laboratory shows that caterpillars constitute the largest item of the fare of the oriole."

Among the other insect-eating birds discussed in this same bulletin are the mourning dove, the jays, the bobolink, the black birds, the sparrows, the grosbeaks, the swallows, the cedarbird, the catbird, the brown thrasher, the chickadee (that does much good by eating the eggs of tent caterpillars), and the robin.

"The Baltimore oriole and the English sparrow have been seen feeding upon the caterpillars of the brown-tail moth and the latter bird also attacks the moths." *

"Thirty-eight species of birds have been identified when feeding upon the gypsy moth in one or more of its forms." †

* Mass. State Board of Agriculture. Bulletin of Information. The Brown-tail Moth. 1898.

† Mass. Board of Agriculture. The Gypsy Moth. 1896.

Fig. 19. Winter nest of brown-tail moth, collected at Kittery, March 30, 1904.

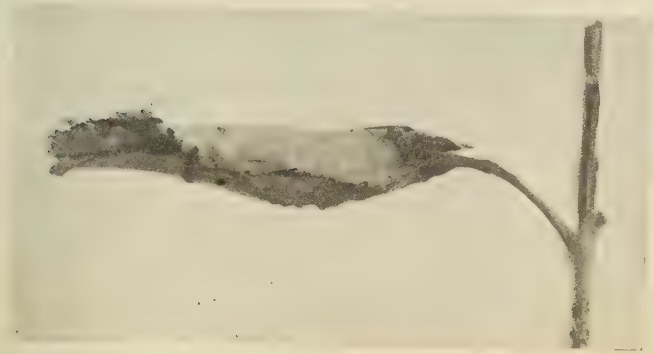


Fig. 20. Cocoon of promethea moth, collected at Kittery, March 30, 1904.

Fig. 21. Cocoon of cecropia moth, collected at Kittery, March 30, 1904.

Fig. 22. Promethea moth. Female.

Fig. 23. Caterpillar of hickory tiger moth, collected at Kittery, Aug. 22, 1904.

Fig. 24 Cocoon of old tussock moth covered with eggs, collected at Kittery, March 30, 1904.

Fig. 25. One of the caterpillars that hatched from the eggs shown in the accompanying figure.

Fig. 26. Red-humped caterpillar.

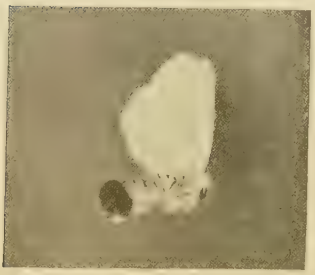


Fig. 27. Brown-tail moth. Female.

THE APPLE MAGGOT (*Rhagoletis pomonella.*)

EDITH M. PATCH AND W. M. MUNSON.

In acknowledgement of, if not in answer to, the appeals for help against the apple maggot, a consideration of this insect seems again to be due. The life history of the apple maggot is well enough ascertained so that the fight against it can be intelligently carried on; and an attempt has been made in this paper simply to bring together such known facts in the life of the pest as have a bearing on the means of combating it. The statements are based in the main upon the investigations recorded in the Monograph on The Apple Maggot (1888-1889) by the late Professor F. L. Harvey.* Independent observations of the advanced larval and early pupal stages have been made, but inasmuch as they serve merely to confirm what has already been done, they are for the most part suppressed.

It has not seemed necessary to restate the detailed work which led to a knowledge of the facts here given. Fifteen years have not brought about any apparent change in the insect. When it was first described for Maine, the apple maggot preferred the softer fall varieties, but was capable of developing in hard winter ones; and it has lost meanwhile neither the preference nor the capability. The apple maggot has of late changed its generic name, but since the transformation has not entered into the nature of the pest, the same things which were true for *Trypeta pomonella* still hold for *Rhagoletis pomonella.*

DESCRIPTION.

Egg.

The light yellow eggs are fusiform and about four times as long as broad, measuring in length from .8 to .9 mm. and in breadth about .2 mm. At the end left nearest the surface of the apple, the egg has a little stalk or pedicel. The ovaries fill most of the abdominal cavity of the female fly. Each side contains twenty-four chains of eggs, each chain having at least seven eggs in different stages of development.

*Report this station for 1889, pp. 190-241.

Larva.

The footless maggot is opaque whitish, with a greenish or more often a yellowish tint. It measures from 7 to 8 mm. in length and is 2 mm. or slghtly less in breadth. The body is composed of fourteen segments, the ninth, tenth and eleventh being the thickest. From the ninth segment the body slopes anteriorly to the pointed retractile head segments. The posterior end is much broader than the anterior and is squarely cut off.

The head end is easily distinguished both on account of its pointed shape and the presence of the dark chitinous jaws, which are hook shaped and serve to dig the tunnels and soften the pulp about the larva. The three anterior segments may be retracted, hiding the hooks. See Fig. 31.

The tracheal system is well developed. Anteriorly there are two ventrodorsal tubercles between the third and fourth segments, the cephalic spiracles. Leading from each of these to a caudal spiracle on the fourteenth segment is a lateral tracheal tube. Between the fourth and fifth segments and the eleventh and twelfth segments, the lateral tracheæ are connected by branch tubes.

Pupa.

In this stage the insect is pale yellowish brown in color and oval in shape. It measures about 4.2 to 5.2 mm. in length and is about half as broad. The pupa remains within the larval skin, which becomes thicker and darker. The pupæ are variable in size, the larger ones being quite possibly the females. Fig. 32.

Fly (female).

The adult female is about 5.8 mm. in length with a wing expanse of 12.15 mm. The head is light brown or pale rusty red. The prominent eyes are green with reddish and steel-blue reflections. The antennae are three jointed, the proximal joint being shortest; the second having numerous short thick black bristles on the inner face; and the distal joint long, rounded at the tip. The mouth parts are pale yellow. The thorax is black, striped with silvery longitudinal lines, and marked with a dorsal white spot. The wings are broad and clear at the base. Four dark cross bands traverse each wing. The margin of the wing is armed with bristles. The legs are yellowish and black, and

the feet are clothed with dark hairs. The abdomen is composed of seven segments, black as to ground color and striped with four white transverse bands. The seventh segment is blunt when the sheath and ovipositor are retracted, but sloping when the sheath is protruded. The ovipositor is brownish, hornlike above, and bears a median groove below which is covered by two flaps, from beneath which the eggs escape. The ovipositor is sharply pointed and somewhat curved at the end. Fig. 30.

Fly (male).

The adult male is smaller than the female, but of the same general color. The abdomen is composed of but five segments and has only three white bands upon it.

LIFE HISTORY.

The flies, a little smaller than the house-fly and readily distinguished by four dark irregular bands across the wings, are found in the apple orchards from about July first until frost. During this time the females are employed laying eggs, by piercing the skin of the apple with a sting-like ovipositor and leaving at each incision one egg buried in the pulp. Each female is capable of laying at least three or four hundred eggs.

From the eggs hatch apple maggots which tunnel through the pulp where they feed until full grown. Often their tunnels lie directly beneath the skin of the apple, showing through in the light colored varieties as dark trailing tracks which have won for the apple maggot the popular name of Railroad Worm. (See fig. 28). But, though the maggot frequently comes near the surface of the apple, it never breaks through the skin and is thus always protected, a circumstance which shows clearly that it is of no use to try to destroy this pest by spraying.

When the eggs are laid, the apples are young and hard and for some time the maggots grow very slowly. At this stage the tunnels are very inconspicuous and the maggots themselves are not likely to be detected except by careful search. As the apple matures, the maggot makes more and more headway and is frequently full grown by the time the apple is ripe. Moreover the presence of the maggots seem to hasten the development of the apples and much of the infested fruit comes to the ground as windfalls. This is the reason so much stress is laid on the destruction of windfalls to get rid of the maggot.

Since the flies are so long on the wing and lay their eggs over such an extended time, the full grown maggots are found at different periods. The first eggs are laid naturally in the early fruit and accordingly as soon as August tenth full grown maggots have been recorded in Early Harvests. On the other hand, some of the later maggots, from eggs laid in harder winter varieties, do not acquire their full size until late in the fall or winter. These are the maggots that are stored with the fruit.

So far as has been observed the maggots are never mature enough to leave the apples before the fruit falls, but the full grown maggots (shown in fig. 31) bore out of the windfalls and bury themselves an inch or less in the ground. Or, if they are in gathered fruit where they cannot find a suitable burying ground, they creep away beneath some protecting object instead. Soon after leaving the apple (sometimes the transformation takes place within the apple but not often) the maggots shrink a little in length and bulge a little in thickness, the skin at the same time growing tougher and slightly darker.

The insect is known in this form (fig. 32) as the pupa, and rests in this stage all winter. With the return of summer a second transformation takes place which is complete when a fly (fig. 30) with banded wings breaks out of the tough skin which has covered the pupa all winter and comes from its hiding place to seek an orchard where it may spend its life laying eggs in the pulp of young apples.

PREVENTATIVE MEASURES.

As pointed out here, it is useless to try to poison the growing maggots as they are within and protected by the apple. It is also evident that if the maggots contained in windfalls and picked fruit are destroyed one year there will be no trouble to fear from them the next. Of course it is highly improbable that even by the greatest vigilance, every maggot could be thus destroyed. But when it is considered that each maggot left to its own devices has a chance of becoming a fly capable of laying at least three hundred eggs, and that each maggot undestroyed this year may mean three or four hundred next year, the importance of killing as many as possible is evident. If the apple maggots, as do many insects, all developed about the same time, the problem would be much simpler, but as full grown maggots

are found in apples from before the middle of August until into the winter, the watch for them must extend over several months.

If enough hogs or sheep to eat the windfalls are kept under infested trees from the second week in August until the fruit is finally gathered, all the maggots in windfalls will be got rid of. Of course the same results, as far as destroying the maggot is concerned, can be obtained by having windfalls faithfully gathered during this time and fed to stock, or made into cider. In some localities the entire orchard will be involved and the task will be a hard and wearisome one, but in many places, where only a few trees are infested, the maggots can be destroyed with comparatively little labor.

Many maggots may be found in fruit at canning time. Here the housewife can help the orchardist by burning infested refuse or killing the maggots with boiling water. Where chickens are kept, the parings can be thrown to them, for they will see that no creeping thing escapes.

Stored fruit remains to be considered. If this is kept in closed boxes or barrels the maggots cannot escape, but will stay in the bottom and enter the pupa state there. As each box is emptied of the fruit, the litter at the bottom in which the little brownish pupæ remain should be carefully poured out and burned.

Another question is, what is to be done with infested fruit on the market? Growers and wholesale dealers can do much to prevent increase of the apple maggot by destroying fruit too much infested to be sold or by giving it to some one with stock. Dealers will not appreciate the danger so much as growers themselves and it would doubtless pay orchardists to explain to dealers in their vicinity the danger from infested fruit and to make some arrangement for disposing of it.

With the home-grown maggots put out of the way, we have still to consider the immigrants coming from other states. Badly infested fruit is imported. It would seem to be well worth while for the State of Maine to prevent this by enacting a law, prohibiting importation of infested apples, with an appropriation sufficient to insure at each entrance port the inspection of imported fruit, at least of the early varieties from which most is to be feared.

The fight against the apple maggot, while exceedingly tedious, is not more difficult than that against many other insect pests. It is useless to wait for simpler or easier methods. Sprays may

reach the codling moth before the larva enters the fruit, but the apple maggot is inside the fruit from the very beginning and is safe from poisons. Again, after the maggot buries itself in the ground it is practically safe, as there is great difficulty in fighting under ground insects. But there is a chance to kill it in the fallen fruit and it must be attacked, if at all, at this its one vulnerable point. The way once made plain, the situation is in the hands of the fruit growers, so far as home orchards are concerned, and in the hands of the State as regards imported fruit.

Since this method of destroying the apple maggot was recommended, some ten or twelve years ago, it has been tried in different parts of the State. In this connection it is interesting to note what a few of the fruit growers of Maine have to say from their experience.

One fruit grower in Androscoggin county who keeps hogs or sheep under most of his trees and picks up the rest of the windfalls, met with a loss from the apple maggot this year of about one per cent of his crop. Another in the same county has picked windfalls carefully and states that the trouble from the apple maggot has decreased the past two years, and he experienced no loss from the pest this year. A third man in Androscoggin county says that he does nothing whatever to prevent the ravages of this pest and reports this present year a considerable loss from the apple maggot. He does not pick up his windfalls, nor does he pasture sheep or hogs in his orchard.

From Cumberland county one orchardist reports less injury for the past two years and thinks it is the result, to a great extent if not entirely, of having the windfalls taken care of as soon as they fall from the tree. He pastures with hogs, sheep, geese, and hens. Another orchard owner in the same county does not keep sheep or hogs under his trees and does not pick up his windfalls. He reports the loss of about one-fifth of his crop this year. He states his belief that hogs or sheep enough to take care of the windfalls would prevent the ravages.

One fruit grower in Franklin county who pastures sheep in his orchard and another who keeps hogs under his trees both state that their loss has been very small this year.

A Kennebec county orchardist says the last few years the apple maggot has not been so bad. He pastures sheep in part of the orchard and keeps his apples picked up. A second man

from Kennebec county picks up his windfalls and reports that there has been no loss this present year with him.

An orchardist from Sagadahoc county states that he picks up the windfalls and that ravages are decreasing. This year he met with no loss from the pest.

From Lincoln county one fruit grower states that there was no money loss from the apple maggot with him this year. He gathers his windfalls every day. A second man from Lincoln county who keeps hogs under his trees says the maggots did less injury this year than any other year since they first appeared.

Of two Penobscot fruit growers who do not take care of their windfalls, one reports a great loss from the maggot and the other a loss of five per cent of his crop. A third man from the same county picks up his windfalls as soon as they fall. This year he had hardly any loss.

An apple grower in Somerset county says that the apple maggot is not increasing as fast with him as in many places and thinks sheep running under the trees keep the pest down to a great extent.

From Washington county a report comes from an orchardist who has not seen any maggots this year, nor can he find on inquiry any one who has. He gathers his windfalls every day and says it is the common practice in that vicinity to gather windfalls carefully and feed them. Several keep hogs in the orchard.

An apple grower in Aroostook county says he has never seen any maggots in apples grown there.

An orchardist in Piscataquis county says the maggot seemed to increase the last four or five years until this year when he met with practically no loss. He keeps the windfalls from early varieties carefully picked.

With one exception all the fruit growers just quoted feed the refuse from stored apples to stock or to poultry.

Besides the foregoing specific statements it remains to be said that some orchardists who have not made a practice of caring for their windfalls have met with but slight loss from the maggot this year. The question naturally arises, are they feeling the influence of neighboring orchards which are tended?

On the other hand, a few apple growers say they have put the fallen fruit out of the way and yet do not find the trouble

decreasing. One of these, however, makes the suggestive remark that the windfalls in neighboring orchards are left on the ground.

It is impossible to ascertain the exact effect, if any, of climatic conditions upon the question. Even if it were possible, the knowledge would probably not prove helpful, for there could be no control of natural climatic conditions on a scale sufficiently large to control this pest.

All things considered, it seems perfectly justifiable to conclude that those orchardists from all parts of the State who have said —"We destroy the windfalls and the trouble is decreasing with us"—have answered their own question as to what shall be done with the apple maggot.

From many counties the reports concerning the varieties damaged came in general terms, indicating that nearly all sweet fall apples and mild sour ones are troubled more than the hard winter fruit.

Although the lists on pages 177 and 178 are not at all complete, perhaps they will not be altogether devoid of interest. They indicate that while in some orchards even the most susceptible varieties may escape infestation, the maggot is capable of adapting itself to most kinds of apples and that there is no certainty that any variety is safe until the orchardist is sure that hundreds of maggots are not burying themselves in his orchard every fall.

The plate facing this page shows, in figure 28, apples with characteristic larval trails which give rise to the popular name, "railroad worm." Figure 29 shows, in cross section of apples, the advanced work of the maggots. Figures 30, 31, 32, represent three stages of the apple maggot—the fly, the larva, and the pupa, all enlarged.

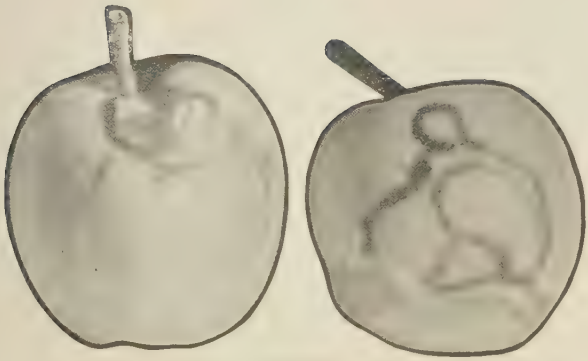


Fig. 28.

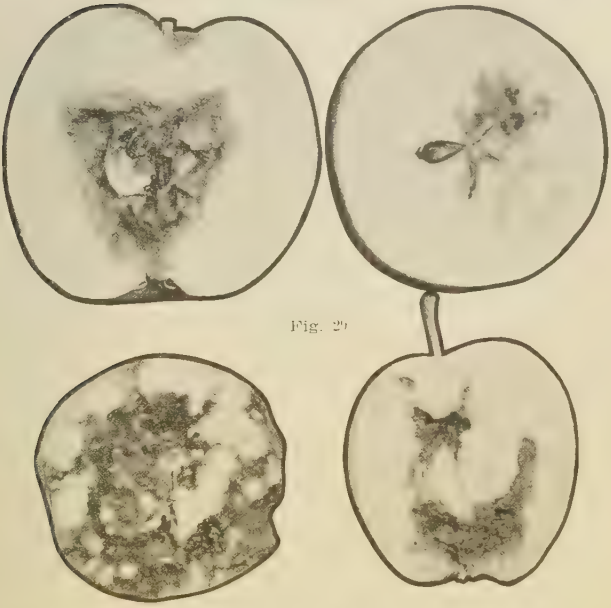


Fig. 29

Fig. 31.

Fig. 30.

Fig. 32.

The apple maggot and its work.

APPLES REPORTED TO HAVE BEEN INFESTED BY THE APPLE MAGGOT.

A * against the county indicates that the variety named has been badly infested in that locality.

	Variety.	County.
1.	August Sweet	Oxford*.
2.	Bailey Sweet	Cumberland.
3.	Baldwin	Penobscot*, Androscoggin, Franklin.
4.	Bellflower	Kennebec, Androscoggin.
5.	Deane	Piscataquis, Lincoln*.
6.	Duchess (Oldenburg)	Lincoln*.
7.	Early Harvest	Franklin*, Cumberland, Androscoggin.
8.	Fameuse	Piscataquis, Lincoln, Franklin, Penobscot*, Kennebec, Oxford*, Cumberland, Androscoggin*.
9.	Foundling	Lincoln*.
10.	Franklin Sweet	Kennebec.
11.	Gravenstein	Penobscot, Androscoggin, Lincoln, Kennebec, Oxford, Cumberland.
12.	Granite Beauty	Lincoln.
13.	Garden Royal	Somerset, Lincoln*, Franklin, Cumberland.
14.	Garden Sweet	Kennebec*.
15.	Golden Sweet	Cumberland.
16.	Haskell Sweet	Sagadahoc.
17.	Harvey	Franklin, Oxford, Androscoggin.
18.	Hightop Sweet	Sagadahoc.
19.	Hubbardston	Sagadahoc.
20.	Hurlbut	Lincoln.
21.	Jewett's Red (Nodhead)	Lincoln, Sagadahoc*, Oxford, Piscataquis, Penobscot*, Kennebec*, Franklin, Cumberland.
22.	King (Tompkins)	Kennebec, Penobscot*.
23.	Kings Graft	Lincoln*.
24.	King Sweet	Somerset*, Lincoln*, Kennebec*, Cumberland.
25.	Ladies Sweet	Cumberland.
26.	McIntosh	Penobscot*, Lincoln*, Oxford.
27.	Milding	Lincoln, Franklin*.
28.	Minister	Sagadahoc.
29.	Moody	Androscoggin.*.
30.	Munson Sweet	Lincoln*, Cumberland*.
31.	Northren Spy	Kennebec, Sagadahoc*, Lincoln, Somerset, Androscoggin, Oxford*, Franklin.
32.	New York Pippin	Kennebec.
33.	Orange Sweet	Lincoln*.
34.	Peach	Cumberland.
35.	Pearmain(Summer)	Kennebec*, Cumberland.
36.	Porter	Kennebec, Sagadahoc, Franklin*, Cumberland, Androscoggin*.
37.	Pound Sweet	Cumberland.
38.	President	Androscoggin.
39.	Primate	Kennebec*.
40.	Pumpkin Sweet	Cumberland.
41.	Red Astrachan	Kennebec, Androscoggin, Cumberland, Sagadahoc, Piscataquis.
42.	Ribstone	Penobscot.
43.	R. I. Greening	Androscoggin, Oxford.
44.	Rolfe	Piscataquis, Somerset, Penobscot*.
45.	Sherwood Favorite	Cumberland.
46.	Spice Sweet	Kennebec.
47.	Spitzenburg	Oxford.
48.	Sops of Wine	Cumberland.
49.	Superb Sweet	Androscoggin.
50.	Sweet Bough	Kennebec*, Oxford*, Cumberland*, Androscoggin.
51.	Talman Sweet	Sagadahoc*, Kennebec*, Somerset, Penobscot, Lincoln*, Androscoggin, Franklin, Oxford*, Cumberland*.
52.	Twenty Ounce	Lincoln, Somerset, Kennebec, Cumberland.
53.	Wealthy	Penobscot, Lincoln,
54.	Winthrop Greening	Kennebec.
55.	Williams Favorite	Cumberland.
56.	Yellow Transparent	Cumberland.
57.	Benoni	Cumberland.

FRUIT REPORTED TO BE FREE FROM THE APPLE MAGGOT, OR ONLY SLIGHTLY ATTACKED, IN SOME ORCHARDS IN THE COUNTIES NAMED.

Variety.	County.
Baldwin	Cumberland, Piscataquis, Sagadahoc, Penobscot, Oxford, Androscoggin, Franklin, Kennebec, Lincoln.
Beauty of Kent	Lincoln.
Ben Davis	Penobscot, Oxford, Lincoln, Kennebec, Somerset, Androscoggin, Franklin.
Benton Red	Penobscot.
Bellflower	Sagadahoc, Cumberland, Androscoggin, Kennebec, Oxford, Somerset, Lincoln.
Black Oxford	Sagadahoc, Penobscot, Androscoggin, Lincoln, Kennebec.
Blue Pearmain	Lincoln.
Danvers Winter Sweet	Lincoln.
English Russett	Lincoln.
Fallawater	Piscataquis.
Gano	Kennebec.
Gravenstein	Lincoln.
Grimes Golden	Lincoln.
Haas	Penobscot, Lincoln.
Harvey	Sagadahoc, Kennebec.
Hubbardston	Androscoggin, Kennebec.
Hunt Russett	Lincoln.
Jewett's Red (Nodhead)	Kennebec, Oxford.
King (Tompkins)	Piscataquis, Sagadahoc, Cumberland, Kennebec, Oxford.
Ladies Sweet	Lincoln.
Maiden Blush	Androscoggin.
Mann	Somerset, Penobscot.
McIntosh Red	Oxford, Androscoggin.
Milding	Piscataquis, Lincoln.
Newtown Pippin	Lincoln.
Northern Spy	Piscataquis, Penobscot, Kennebec.
Porter	Lincoln, Kennebec.
Red Astrachan	Kennebec, Somerset.
Red Canada	Kennebec.
Red Russett	Kennebec.
Rhode Island Greening	Piscataquis, Sagadahoc, Penobscot, Kennebec, Androscoggin, Lincoln, Somerset, Cumberland, Oxford.
Rolfe	Androscoggin.
Roxbury Russett	Kennebec, Somerset.
Russett	Sagadahoc, Penobscot, Androscoggin, Oxford, Lincoln, Kennebec, Franklin.
Spitzenburg	Sagadahoc, Lincoln, Somerset.
Stark	Piscataquis, Penobscot, Franklin, Kennebec, Lincoln, Somerset.
Starkey	Lincoln.
Tallman Sweet	Lincoln.
Wagener	Penobscot, Androscoggin, Lincoln.
Wealthy	Sagadahoc.
Westfield (Seek-no-Further)	Androscoggin.

INSECT NOTES FOR 1904.

EDITH M. PATCH.

The situation for this year is marked especially by an immigration of brown-tail moths, *Euproctis chrysorrhœa*, to the southern part of the State in July; the reappearance of the white-marked tussock moth, *Notolophus leucostigma*, in the shade trees of Portland; the occurrence of the red-humped caterpillar, *Œdemasia concinna*, in all parts of the State; a conspicuous outbreak of the cottony grass-scale, *Eriopeltis festucæ*, in many localities; and a general infestation of aphids.

Just the right conditions (whatever they may be) have existed for aphids this summer. From April to November black alders have been white stemmed with *Schizoneura tessellata* as shown in fig. 33. About the middle of July the maples along the Penobscot were clustered thick upon leaves and leaf stems with aphids of the same genus, and the river two miles above Old Town had a milky white cast caused by the bodies and molts. In June whole hillsides were sticky with honey dew, the coniferous trees present being covered with aphids which for the most part belonged to the genus *Lachnus*. The leaves of apple, elm highbush cranberry, snowball, and currant are among those which were especially attacked. *Chermes pinicorticis* was conspicuous in some localities on white pine. Perhaps the most interesting of the gall producing aphids present is a species of Chermes which is distorting the branches of the Norway and red spruces in eastern Maine. The open cone-like gall of this aphis is shown in fig. 34.

As would be expected, numbers of insects were attendant upon the aphis colonies. Five species of fireflys, *Lampyridæ*, were common upon infested bushes in June; the first of July lacewinged flies, *Chrysopidæ*, were shyly darting about the woods while their progeny of aphis lions were ravaging colonies of plant lice; all through the season striped syrphus flies (fig. 37) could be seen hovering about and their larvæ (fig. 36) could be found everywhere waxing fat in aphis clusters; the lady beetles were not so numerous as might be wished, though eight species were taken at Orono in May and June. Of the insects which

were attracted by the honey dew, ants were present in the usual numbers; and in August three species of yellow jackets were very numerous about the leaves and upon the ground under those species of aphids which secreted most honey dew.

The larvæ of a drone fly, *Eristalis tenax,* is never found without arousing curiosity. Fig. 46 will show why it is called the rat-tailed larva. This maggot lives in such places as cesspools, and the "tail" is really an extended breathing tube the tip of which the insect elevates into the air and is so able to breathe, although the rest of its body is buried in fluid matter. The adult insect frequents flowers.

The willow cone gall, shown in fig. 43, is another common object concerning which questions are often asked. This gall is caused by a gnat, *Cecidomyia strobiloides*, about the size of a mosquito, which deposits an egg in the willow buds early in the spring. The subsequent growth of the willow leaves is abnormal and they cluster into a close cone-like object, in the heart of which is a larval cell (fig. 42) containing the yellowish pink maggot. Here the insect passes the winter, and the adult gnat emerges at the time the willows are budding, about the middle of May here in Orono.

Robber flies, *Asilidæ*, are frequently brought to the station, their queer shape or peculiar manner attracting attention. Two were found this summer preying upon the cabbage butterfly, *Pieris rapæ*, (see fig. 39) and their rapacious appetite leads to the destruction of many insects, the honey bee among them, a fact not enjoyed by bee keepers.

Among the most important natural factors in helping to keep injurious insects within bounds are the ichneumon flies. Although the various species differ in size and color, fig. 38 will serve to illustrate the characteristic form of many of these beneficial insects.

The slow-flying Pelecinus, fig. 35, has been common enough to cause considerable inquiry. No detailed studies have been recorded, but it is reported to be parasitic upon the white grub, fig. 45, the young May beetle, fig. 44.

Other insects important in the economy of nature are the numerous carrion beetles that dispose of decaying flesh which they find in fields and woods. Fig. 41 represents one large genus, *Silpha,* of these scavengers.

The beautiful maple borer, *Plagionotus speciosus*, fig. 40, was received from Monmouth the middle of July. The insect lays its eggs about this time in the bark of hard maples and the larvæ bore into the wood. Their presence is made known in the spring by the dust that is pushed from their tunnels, and the borers can be destroyed by a knife and a wire, as in the case of the apple tree borers.

During the year a number of insects have been received from correspondents for identification. A list of these with notes is given in the following table. In addition to these, a few other animals have been received and examined. These include: Nematode worms, from salt cod fish. The flesh bordering the alimentary canal was filled with encysted worms, which were more than an inch in length. Millipedes. Numerous in a cucumber house at York Corner, where they spoiled most of the cucumbers. Trap door spider, *Theraphosidæ*. Received from Levant, though evidently a southern species.

INSECTS RECEIVED FOR IDENTIFICATION.

Name.	Date.	Host.	Locality.	Remarks.
Cecropia moth, *Samia cecropia*	March 20	Apple	Madison	Cocoon, "only one seen."
Cecropia moth, *Samia cecropia*	March 29	Apple	Kittery	Cocoon, only one seen in orchard.
Cecropia moth, *Samia cecropia*	April 1	Apple	Caribou	Cocoon, four on one tree "not seen before."
Cecropia moth, *Samia cecropia*	May 9	Apple	South Presque Isle	Cocoon, "only one found."
Promethea moth, *Callosamia promethea*	March 30	Wild cherry and barberry	Kittery	Cocoon numerous, mostly parasited.
Old tussock moth, *Notolophus antiqua*	June 14	Apple	Lewiston	Larvæ.
Old tussock moth, *Notolophus antiqua*	March 29	Apple	Kittery	Egg clusters.
Old tussock moth, *Notolophus antiqua*	Oct. 18	Apple	South Paris	Larva.
White-marked tussock moth, *Notolophus leucostigma*	March 29	Apple	Kittery	Egg clusters.
White-marked tussock moth, *Notolophus leucostigma*	Aug. 18	Elm	Portland	Cocoons. Shade trees badly infested.
White-marked tussock moth, *Notolophus leucostigma*	April 26	Apple	Orono	Egg clusters.
Well-marked tussock moth, *Notolophus definita*	Aug. 4	Dogwood	Orono	Larvæ nearly grown.
Brown tail moth, *Euproctis chrysorrhœa*	March 30	Pear	Kittery	Winter nests, common.
Brown-tail moth, *Euproctis chrysorrhœa*	Aug. 22	Pear	Kittery	Young colonies, numerous.
Lesser apple leaf folder, *Teras minuta*	June 3	Apple	Skowhegan	Larvæ.
Fall web worm, *Hyphantria cunea*	Aug. 4	Apple	Albion	Larvæ.
Fall web worm, *Hyphantria cunea*	Aug. 29	Apple	Eliot	Larvæ.
Fall web worm, *Hyphantria cunea*	Sept. 2	Apple	Foxcroft	Larval molts.
——*Clemicha virginica*	June 9	Grasses		Cocoon found in apple tree.
——*Clemicha virginica*	June 20	Grasses	Farmington	Two cocoons, one was parasited.
——*Lycomorpha pholus*	Aug. 19	Lichens	Sebago Lake	One moth.
Cut worm, *Feltia subgothica*	Aug. 10		East Sangerville	Moths common.
Chain-streak moth, *Cingilia catenaria*	Sept. 22		Orono	Moths common.
Great tiger moth, *Arctia caia*	July 28		Orono	Moth.
Isabella tiger moth, *Pyrrharctia isabella*	July 14		Orono	Moth.
Handmaid moth, *Datana ministra*	Aug. 12	Apple	East Bangor	Larvæ.
Red-humped caterpillar, *Oedemasia concinna*	Aug. 12	Apple	Skowhegan	Larvæ, "many in orchard."
Red-humped caterpillar, *Oedemasia concinna*	Aug. 27	Apple	Dexter	Larvæ.
Red-humped caterpillar, *Oedemasia concinna*	Aug. 29	Apple	Eliot	Larvæ, all parasited.
Red-humped caterpillar, *Oedemasia concinna*	Aug. 4	Apple	Turner	Larvæ.

Red-humped caterpillar, *Oedemasia concinna*	Aug.	12	Apple	Wiscasset	Larvæ.
Red-humped caterpillar, *Oedemasia concinna*	Aug.	18	Apple	Sebago Lake	Larvæ.
Red-humped caterpillar, *Oedemasia concinna*	Aug.	22	Apple	Kittery	Larvæ.
Red-humped caterpillar, *Oedemasia concinna*	Sept.	2	Apple	Farmington	Larvæ.
Red-humped caterpillar, *Oedemasia concinna*	Sept.	8	Apple	Skowhegan	Larvæ.
Red-humped caterpillar, *Oedemasia concinna*	Sept.	9	Apple	South Ampton, L. I.	Larvæ.
Red-humped caterpillar, *Oedemasia concinna*	Oct.	3	Apple	Orono	Larvæ and cocoons.
Glassy cut worm, *Hadena devastatrix*	July	20		Foxcroft	Moth.
Cut worms, ———	Aug.	4		Seal Harbor	Larvæ.
Clear-wing moth, *Sesiidae*	July	7	Rose	Hulls Cove	Larvæ.
Achemon sphinx, *Philampelus achemon*	Sept.	5	Apple	Farmington	Larvæ full grown.
Blind-eyed sphinx, *Paonias excæcatus*	Sept.	9	Apple	Houlton	Larvæ full grown.
Mourning-cloak, *Evanessa antiopa*	July	28	Willow	Portland	Larvæ molts.
——*Grapta faunus*	Aug.	10	Willow	East Sangerville	Butterfly.
Cottony grass scale, *Eriopeltis festucæ*	April	6	Grass	Sedgwick	Egg sacs in meadow, numerous.
Cottony grass scale, *Eriopeltis festucæ*	July	20	Grass	Gorham	Egg sacs, common.
Cottony grass scale, *Eriopeltis festucæ*	July	28	Grass	Dresden	Egg sacs, ground covered.
Cottony grass scale, *Eriopeltis festucæ*	July	28	Grass	Eggemoggin	Egg sacs, thick on stalks.
Cottony grass scale, *Eriopeltis festucæ*	Aug.	3	Grass	Orono	Egg sacs, not common.
Cottony grass scale, *Eriopeltis festucæ*	Aug.	4	Grass	Portland	Egg sacs, badly infested.
Cottony grass scale, *Eriopeltis festucæ*	Aug.	6	Grass	Manchester	Egg sacs, infestation bad.
Plant louse, *Aphis Sp.* (?)	Aug.	29	Rose	Sagadahoc	
Green apple aphis, *Aphis mali*	Jan.	25	Apple		Eggs near leaf-scar on twig.
Green apple aphis, *Aphis mali*	June	26	Apple	Dover	
Green apple aphis, *Aphis mali*	Aug.	29	Apple	South Smithfield	On grafts.
Plant louse aphis, *Aphis Sp*	June	20	High bush cranberry	Seal Harbor	Leaves curled. Syrphus fly larvæ present.
Honey-dew on leaves	June	21		Abbot	"Nearly everything covered for miles."
Potato aphis, *Aphis Sp*	Aug.	12	Potato	Houlton	Common.
Alder blight, *Schizoneura tessellata*	April	26	Alder	Orono	Larval clusters common.
Woolly elm aphis, *Schizoneura americana*	June	11	Elm	Brunswick	In curled leaves which serve as a protection.
Woolly louse of the apple, *Schizoneura lanigera*	July	31	Apple	Gorham	In crevice on tree trunk.
——*Lachnus (abietis* probably)	June	10	Fir	Augusta	Giant dark aphids. Wingless form eggs near leaf scars on twigs.
Spruce gall aphis, *Chermes*——?	June	23	Spruce	Orono	Galls common on Norway spruce.
Oyster shell scale, *Mytilaspis pomorum*	Aug.	11	Apple	Portland	Twigs badly incrusted.
Leaf hoppers——?	June	25	Apple	West Falmouth	Larvæ.

INSECTS RECEIVED FOR IDENTIFICATION—CONCLUDED.

Name.	Date.	Host.	Locality.	Remarks.
Tarnished plant bug, *Lygus pratensis*	Sept. 13	Asters	Ellsworth	Larvæ and adults.
Black damsel bug, *Corisacus subcoleoptratus*	July 14		Orono	Larvæ, short winged.
Fleas			South Freeport	Troublesome in poultry houses.
Hair lice, *Trichodectes*				Troublesome on horses and cattle.
Croton bugs, *Ectatta germanica*			Corinth	"A great pest about the house."
Lace winged fly, *Chrysopa*	July 20	Aphids	Orono	Eggs on alder leaf.
Syrphus fly, *Syrphus*———	July 7	Aphids	Orono	Larvæ common among *Schizoneura tessellata*.
Robber fly, *Asilidæ*	July 23		Old Town	Caught preying upon cabbage butterfly.
Rat tailed larva, *Eristalis tenax*	Sept. 28			Two pupal molts from stable floor
Pigeon horn tail, *Tremex columba*	Aug. 10		Waterville	Female.
Cuckoo fly, *hegsidida*	June 21		Orono	Female.
——— *Pelecinus polyturator*	Aug. 10		Orono	Female.
Ichneumon fly, *Thalessa lunata*	July 30		Orono	Female.
Strawberry crown girdler, *Otiorhynchus ovatus*	Aug. 8		Maysville Center	About edge of carpet.
Strawberry crown girdler, *Otiorhynchus ovatus*	Aug. 13		Monson	"House full of them."
Strawberry crown girdler, *Otiorhynchus ovatus*	Aug. 17	Grass roots?	Houlton	Numerous in meadow.
Two-spotted lady beetle, *Adalia bipunctata*	Sept. 17	Aphids	Hallowell	Pupæ and adults on birch leaves.
Lady beetle———	June 28	Aphids	Bar Harbor	Larvæ on rose bush.
Herbivorous lady beetle, *Epilachna borealis*	July 6		Auburn	Cluster of larvæ molting on bark of plum tree.
Larder beetle, *Dermestes lardarius*	May 23		Orono	Adults in woodbox.
Larder beetle, *Dermestes lardarius*	June 20		Rangeley	Great numbers in cottage where rats and mice had been poisoned the fall before.
Silvanus surinamensis	Jan. 7	Corn flour	Orono	700-800 adult beetles in ¾ quart flour.
Beautiful maple borer, *Plagionotus speciosus*	July 15		Monmouth	Adult.
Carrion beetle, *Silpha americana*	May 13		Orono	
Rove beetle, *Staphylinidæ*	Aug. 1		Dresden	On mushroom.
——— *Ips fascatus*	Aug. 17		Portland	Beetles common in meadow.
Three spotted doryphora, *Doryphora clivicollis*	Aug. 22	Milkweed	Kittery	Larvæ and adults.
Asparagus beetle, *Crioceris asparagi*	June 15	Asparagus	Orono	Adults common in garden.

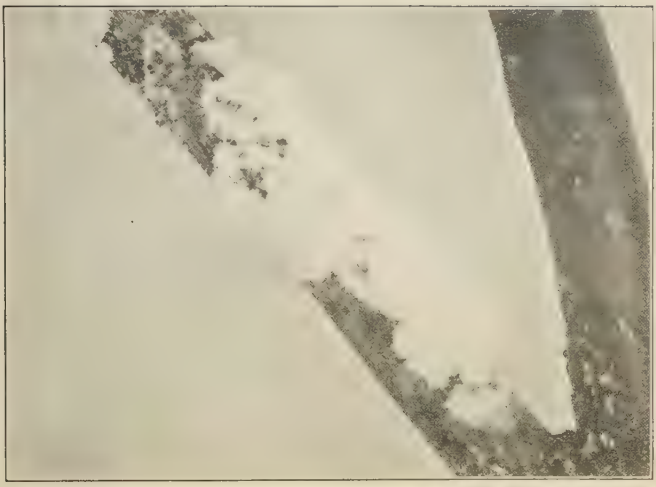


Fig. 33.
Black alder infested with alder blight, *Schizoneura tessellata.*

Fig. 34.
Cone-like gall of aphis common on the Norway and red spruces in eastern Maine.

CONCERNING INSECTS FOR IDENTIFICATION.

In order that the Station may keep in touch with the insect situation in different parts of the State, it is exceedingly desirable that specimens from different localities should be received for identification. Frequently it happens that a species concerning which some fact is yet unknown will occur in such numbers in a certain locality that it can be studied easily there, although it may be rare in other parts of the State, and news of an occurrence like this is always helpful. Insects which are sent to the Station furnish data concerning the extent of injury by species long known to be present in the State, their spread and often the parasites attending them. Also there are many insects troublesome in other states (conspicuous among them the gypsy moth and the San Jose scale) which have not yet been found in Maine. It is important that such pests should be discovered as soon as possible after their arrival.

Directions for Sending Specimens.

All inquiries about insects, injurious or otherwise, should be accompanied by specimens, the more the better. Such specimens, if dead, should be packed in tissue paper or cotton and inclosed in a box. Dead specimens, if particularly soft, may be packed in cotton saturated in alcohol. Whenever it is possible, larvæ (i. e., grubs, caterpillars, maggots, etc.,) should be packed alive in a box together with a supply of their food. Air holes are never needed for the journey, no matter how tight the box. It is often of great practical importance to have accompanying the specimens such particulars as where and when the insect was found, whether it seemed to be destroying leaves, buds, or stem, how long it has been known to the sender, and the amount of damage it has done.

Packages go by mail for one cent per ounce. They should bear the name of the sender and be addressed,

MAINE AGRICULTURAL EXPERIMENT STATION,

Orono, Maine.

THE COTTONY GRASS SCALE.

Eriopeltis festucæ (Fonsc.).

EDITH M. PATCH.

Economic Significance.—Until recently the cottony grass scale has not seemed to merit treatment from the economic standpoint, for the experience of this insect since it was first observed in America had led to the conclusion that it would be an intermittent thing very quickly brought under control by natural agencies.

During the summer of 1904, however, considerable consternation was caused in several localities in Maine by the presence of the egg sacs of this scale in enormous numbers. From Sedgwick and all along the Eggemoggin Reach; from the vicinity of Portland, especially at Gorham and Stroudwater; from Dresden and from Manchester, came persistent and alarmed reports. "My mowing lands look as though scattered with swollen rice grains," "A strange fungus has destroyed large plots in my grass lands," "The hay fields look as if a slight shower of snow pellets had fallen over them," were among the descriptive comments.

This infestation doubtless was not so sudden as it seemed. The scale is inconspicuous until the egg sac is secreted, thus for most of its life only a careful search would reveal its presence. The egg sacs themselves are only about one-fourth of an inch in length and these could be scattered along fence and road ways, over uncut grass near streams, unnoticed for years, and in view of the fact that comparatively few people are keen observers of little things not in their special line of interest, the statements that "we have never seen anything like this before," do not necessarily signify that the creatures have not been breeding within stone's throw for 40 years. However, the cottony grass scale is admirably fitted for rapid increase as the enormous

number of eggs in a sac (600 to 700), the lively disposition of the young scales and their ability to travel, and the fact that there are at least two broods a season, all indicate.

The insidious approach of this insect may be illustrated by this experience. During th late summer and early fall of 1904 in the vicinity of Orono, careful searches were made for egg sacs over large areas, some of which appeared to be entirely free from the scale and others attacked in an exceedingly scattering manner. This fall, 1905, the increase in the places of scattering infestation is very marked, and even over some areas apparently free last season the egg sacs are a common though not yet a conspicuous occurrence. In one Orono meadow which contained an infested plot last fall, the egg sacs have increased certainly one hundred fold in a year's time.

NATURAL CHECKS.

Whether such increases are occasions for real alarm is a question involving a consideration of natural agencies as checks.

Weather.—While the eggs within the sacs are safe in ordinary climatic conditions, the young larvæ, minute, delicate, and unprotected, must be largely dependent upon favorable conditions between the time of leaving the sac and settling upon a promising blade. A heavy rain at this time must undoubtedly beat down and destroy myriads of the little creatures.

Rust.—In a meadow near Portland thickly infested with the scales, areas half a mile in length were observed to be attacked heavily by rust. This was the 25th of August, 1904, when many of the scales were from one to three weeks old. The situation of the rust spots along the leaf resembled so closely the position selected by the scales that it suggested the possibility of some relation between the rust and the scales. In view of the fact that fungi are predisposed to attack parts of plants wounded by insects or in other ways, it seems legitimate to conclude that the grass rusts in scale infested meadows would be most likely to settle at places punctured by the scales. The development of rust could not but interfere with the scales upon the same leaf, and death of the scales result indirectly from the presence of the rust. It was an interesting, if not a significant circumstance, that in the Portland meadow the rust was much more conspic-

uous in the places where there were most egg sacs of the grass scale and where the blades must have been freely punctured by the young scales. Yet on the blades most attacked by the rust no living scales remained. There seemed to be no practical way of obtaining reliable data in this case, but there would be nothing extraordinary in a reduction of scales through the weakening of the host plant by fungus agencies. Such a remedy, however, would prove a severe one for the hay crop.

Predaceous Insects.—Large numbers of fresh egg sacs were frequently observed (1904 and 1905) to be torn open near the end or at the side, and a considerable portion of the eggs in such cases would be missing. This seemed to be the work of some predaceous insects, but none were observed in the act.

Overcrowding.—Sometimes more young scales than one leaf could possibly support are found crowded upon a single blade. In such cases death of some of the scales must result, or a drying of the blade which would cause the death of all the scales upon it.

Parasites.—Nor are parasites lacking. For one test lot nearly two quarts of egg sacs were collected August 1, 1904, in a meadow near Portland. On August 3, such numbers of the minute larvæ hatched and swarmed over the jars that it seemed improbable that parasites were present to any appreciable extent. Two days later, however, parasitic hymenoptera began to emerge. There were more than 100 of these, among which a new species of *Eunotus* and a species of a new genus were about evenly represented, and there were a few of a new species of *Microterys*. About 30 parasitic dipterons, *Leucopis nigricornis* Egger., a European species, also emerged from this lot. Less than 150 parasites from many thousand sacs, however, would not mean an extended diminution of the scales for that generation.

The following year, 1905, about the middle of August, egg sacs were collected near Orono for greenhouse observations. These were too extensively parasited to yield a sufficient number of larvæ for the experiments planned. From 262 sacs collected about the same time from the Isle of Springs, 98 hymenopterous parasites emerged. No dipterous parasites appeared in this collection.

This will suffice to show that among the natural agencies that tend to check the increase of cottony grass scale, parasites are especially efficient. A list of the parasites reared during two years' observation of Maine material is given on a subsequent page.

NATURE OF INJURY.

Like plant-lice and other hemipterous insects, scales weaken their host plant by piercing the tissues with their sharp pointed beaks and sucking the sap. Sometimes as many as 10 or 12 egg sacs are found attached to one blade, which means that for weeks, 10 or 12 scales have been draining sap from that blade. Where the infestation is excessive the result is dead grass and brown plots here and there through the field. Where the infestation is less serious, it still means a shrinkage in the hay crop corresponding to the amount of grass which has been impoverished through the loss of sap. During 1904 and 1905 the places of worst infestation in certain Portland meadows were revealed by irregular brown areas of dead grass.

REMEDIAL MEASURES.

The point in regard to the life history of this insect which is most significant in view of remedial measures is that the scale passes the winter in the egg stage within the white egg sacs attached to the grass blades, well up above the ground. Thus a spring burning of the infested grass land will destroy the whole generation unhatched, without injury to the grass. In some instances this will mean a burning over of more than 50 acres, but in some the infestation is as yet restricted to spots a few rods square here and there in the meadows. It is advisable in districts where the scale has been especially conspicuous to burn the grass along roadsides and in neglected corners, either in the early spring or in the fall, so that such places will not serve as breeding places for the scale.

It is not improbable that if the fields should be left to themselves the parasites, or other natural agencies, would in time master the scales and the grass lands contain only scattered scales which would do practically no harm. As it is quite impossible to predict whether such an adjustment, were it to

come about, would take 2 years or 20, it is certainly much safer to relieve the parasites of the responsibility and burn over the badly infested grass lands. Owners of grass lands can with comparative ease control the situation, and failure to destroy the pest is likely to place a heavy tax upon the hay crop in the infested districts.

A practical demonstration of the worth of this remedial measure was given on Deer Isle last spring (1905). The meadows there had been seriously attacked by the grass scale for several years. During the summer of 1904 the hay crop was reckoned at a third less than the usual amount and the hay was reported to be inferior in quality. Several of the fields were burned over the following spring. Concerning this, one of the meadow owners writes about October twentieth, "We have hardly seen a scale since burning the land last spring. The hay crop was unusually large and we think it did the land good to burn it over."

LIFE HISTORY NOTES.

Description and Habits.—The white egg sacs, appearing like "a strange fungus" attached to grass blades, are what have attracted attention to the cottony grass scale. This is not a stage of progressive injury, but of quiescence. The eggs deposited by the fall brood of scales winter in the protective oval cases. The active larvæ emerge during the warm spring days and seek a suitable grass blade. That they are able to travel for a considerable distance at this time was proven by the sprightly journeys of these microscopic creatures in the laboratory. In confinement as many as 50 have been observed to settle upon one grass blade. (Figures 2 and 3). In the field a single blade with 12 full sized egg sacs is sometimes found, though the number is usually much less. Probably more than 12 could scarcely mature upon one leaf, but 20 to 30 young scales to the blade were not at all an unfrequent occurrence in Portland meadows. Once accepting a favorable location, the young scale must abide by its decision, for after piercing the blade with its minute beak the insect becomes stationary, the legs atrophy and a little clear delicate scale rests flat upon the blade, continuously draining the plant of sap. The scales invariably settle head down the blade, sometimes on the under side but more frequently

on the upper surface. What the physiological effect would be of imbibing constantly for 6 to 11 weeks in this position might seem a trifle uncertain as a matter of conjecture, but it certainly works all right as a practical demonstration and when the time finally comes to secrete the egg sac, the advantages of this peculiar habit become evident. During July when the scale has attained full size, a snow white felty covering of curly filament is secreted, fitting closely over the entire body. If the secretion is removed before the female has begun to deposit eggs a plump, smooth, oval, slightly pink, object is found to be quite filling the closed sac. When it begins to deposit eggs, the female scale pushes the anterior end of its body through the sac in front, breaking open the end pointed downward. Then slowly contracting as the eggs are laid, the scale becomes, by the time the sac is filled with eggs, a shrivelled helpless object already nearly dead. Sometimes it remains in the opening forming a plug for the sac, but more often it drops to the ground.

The oval sac is usually slightly more than quarter of an inch in length. One fair sized sac contained 740 pinkish yellow eggs. The closed end being directed uppermost, the eggs are more thoroughly protected than otherwise would be the case. Enough filaments of the sac are scattered among the eggs to hold them in place.

The eggs of this summer generation hatch in July and August, and the scales mature in the fall, secreting before winter (in October and early November for Maine) sacs in which the eggs remain until spring.

The Male Scales.—No adult males were captured during the two seasons. Three male pupæ were found among 136 mounted scales taken from grass blades in Portland, August 17, 1904. The wing pads, antennæ and legs were distinct in all. One was more nearly mature than the others and seemed about to emerge. Most of the female scales mounted at this time range from 1½ to 3 millimeters. The male pupæ are less than 1½ millimeters long, while a full grown female scale often measures a little over 6 millimeters. The male scales would naturally be expected to appear before the females begin to secrete the cottony covering.

Number of Generations.—From the middle of July to August 4, 1904, freshly formed egg sacs as well as egg sacs from which

larvæ were emerging were collected in great numbers at Gorham, Portland, Dresden, and along the Eggemoggin Reach. From the middle of October to November 3, 1904, the females were observed to be secreting egg sacs and depositing eggs in fields near Orono, Portland, and Sedgwick, and unhatched egg sacs were gathered in Portland, November 22, 1904.

Field data, and material sent to this station during 1904 were sufficient proofs of two generations, the first maturing and secreting egg sacs in July and the first of August, and the second depositing eggs (in sacs as before) during late October and early November. In this egg stage the insect winters, the young scales emerging in the spring.

Life Cycle.—On several occasions, from sacs gathered from different parts of large fields on the same day and kept in jars in the laboratory, all the larvæ emerged within a few days of each other. Thus it seemed probable that the life cycle was passed with considerable evenness and regularity. But this conclusion was contradicted by the circumstance that on August 1-4, 1904, there were found, within a few feet of each other, sacs in which the eggs were not yet hatched, others from which larvæ were emerging and scales of various sizes ranging apparently from one to three weeks in age.

There was no way to tell from field observations as to the exact length of the scale life, so April 12, 1905, egg sacs were gathered for laboratory observations. Many of these were hatched April 28 and the larvæ were liberated upon transplanted June grass sod in the greenhouse. They settled upon the grass readily, over 50 placing themselves upon single blades in some cases. In about two weeks when the scales were well established the sod was again transplanted to cold frames where the conditions were much as they would be in the open field. They were exposed to much cold weather and considerable rain. On July 12 nine plump sacs newly filled with eggs were picked. It had been 11 weeks from the hatching of the scale to the deposition of eggs within the sac. Some of the scales in this lot were not so far advanced and had not begun to deposit eggs, although the scales were covered with a thin cottony secretion.

An interesting check to these observations was found in a second lot which had developed in the greenhouse upon redtop. The newly hatched larvæ were liberated on June 16. On July

19, they were secreting the white sacs and were as far advanced as the slower portion of the cold frame lot, which were 11 weeks old.

As the foregoing observations show, the time required for development depends much upon the temperature, and it seems fair to conclude that a long hot season might give opportunity for 3 broods where the scales are favorably situated. A cold wet summer would probably preclude the development of more than two broods. This seems to be the usual number for Maine, but with such circumstances as scales within a few feet of each other ranging from one day to at least a month in age it would be difficult to be sure that 3 generations were not a frequent occurrence in warm sunny fields.

A simple test was made with 3 lots of eggs as to their power to withstand cold under unnatural conditions.

On April 28, two sealed jars containing egg sacs from which the larvæ were beginning to emerge were placed in a refrigerator. These were labeled No. 1 and No. 2. A third jar, No. 3, was filled the same day with egg sacs newly gathered which had not begun to hatch. These jars remained in the refrigerator until June 6 when they were placed in the greenhouse. June 16 the eggs in jar No. 3 began to hatch. The larvæ were liberated among red-top upon which they settled. These developed, secreting egg sacs from the 19th to the last of July. Seven weeks retardation by cold did not injure these eggs. The eggs in jars No. 1 and No. 2 subjected to the same treatment did not hatch. These, however, were just on the point of hatching when they were placed in the refrigerator and were taken at an unfair advantage.

KINDS OF GRASSES INFESTED.

The egg sacs collected in Maine have been upon June grass, *Poa pratensis*, and red-top, *Agrostis alba*. Where specimens have been sent in on broken bits of grass, as is frequently the case, identification of the host was of course impossible; but so far as the observations of the past two seasons have gone, these are apparently the only two infested grasses yet reported for Maine.

PARASITES.

A large number of egg sacs was collected from June grass in a meadow near Portland the first of August, 1904. For the most part the material was cut close to the sacs, with only a bit of the grass blade left attached. There was included, however, a little infested grass, cut stalk and all, a circumstance which will doubtless account for the presence (in the list appended) of *Lasioptera* and *Isosoma,* insects of grain, or grass-stalk inhabiting proclivities. The single specimen of *Eupelmus* may not necessarily, therefore, have been parasitic upon the grass scale itself. Considering the fact that some species of *Oscinis* are stem maggots and that the larvæ of many species of the same genus are reported as preying upon Coccidae,* the economic position of the two specimens of this insect may also be open to question at present. The remaining species, however, are bred from egg sacs of *Eriopeltis festucæ.* No. 11 and No. 12 were reared from material collected on Isle of Springs, August 9, 1905.

These insects were submitted to Dr. L. O. Howard, chief of Bureau of Entomology, U. S. Department of Agriculture, whose kindness in examining them makes this report possible. All of the Hymenoptera were examined by Dr. W. H. Ashmead, U. S. National Museum, to whom thanks is also due. The following insects are listed as Dr. Howard reported them, except for the addition of the number of specimens reared in each case.

No. 1. *Leucopis nigricornis* Egger. 30 specimens.
2. *Eunotus* n. sp. 36 specimens.
3. New genus near *Phaenodiscus* in Mirini. 32 specimens.
4. *Microterys* n. sp. 4 specimens.
5. Probably males of No. 3. 18 specimens.
6. *Lasioptera* sp. 1 specimen.
7. *Eupelmus* sp. 1 specimen.
8. *Isosoma* sp. 1 specimen.
9. *Lasioptera* sp. 1 specimen.
10. *Oscinis* sp. 2 specimens.
11. *Eunotus* n. sp. How. Many specimens.
12. *Eunotus* n. sp. How. Many specimens.

* U. S. Dept. Agr., Div. of Ent., Bul. 32, p. 35.

BIBLIOGRAPHY.

The published accounts of this insect are meagre, as little attention has been paid to it.

An interesting popular description of *Eriopeltis festucæ* given by Mr. E. A. Butler in Knowledge, July 2, 1894, p. 148, reads as follows:

"This forms little compact oval tufts, like pieces of cotton wool, attached to the stems and blades of certain grasses, and there is certainly nothing whatever in their external appearance to suggest any connection with insects, unless, indeed, they might be cocoons of small ichneumon flies. But a close examination, revealing a number of separate threads standing out in all directions, would soon dispel this idea, and would leave their real nature as problematic as ever. Though apparently not uncommon, they have not long been generally known in this country (England) having previously, no doubt, been overlooked, partly because of the little attention that was until recently paid to the Coccidæ, and partly because of the completeness of their disguise. They seem to have been first noticed in this country in 1856, when there is a reference to them in the *Proceedings of the Entomological Society of London;* but that was soon forgotten, and they passed out of knowledge till 1885, when Mr. Q. C. Bignell again called attention to them."

Dr. James Fletcher, in his report of the Canadian Experimental Farms for 1895, (Ottawa, 1896) pp. 145-147, gives an account of an outbreak of the cottony grass scale with references to literature.

Following are references to the Genus Eriopeltis as corrected by Mrs. C. H. Fernald from her catalogue * of the Coccidæ of the World.

GENUS ERIOPELTIS Sign. Type, *lichtensteinii.*

Eriopeltis, Sign., Ann. Soc. Ent. Fr., (5), i. p. 429 (1871): Ckll., Can. Ent. xxxi, p. 332 (1899).

I. ERIOPELTIS BRACHYPODII Giard.

Eriopeltis brachypodii Giard, Bull. Soc. Ent. Fr., (7), iii, p. cxcix (1893).

* Mass. Experiment Station, Bulletin No. 88.

Eriopeltis brachypodii Butler, "Knowledge," p. 148 (1894).

Eriopeltis brachypodii Fletcher, Rep. Can. Exp. Farms, p. 146 (1896).

Habitat.—France.

On Brachypodium pinnatum.

2. ERIOPELTIS FESTUCÆ (Fonsc.).

Coccus festucæ Fonsc., Ann. Soc. Ent. Fr., iv. p. 216 (1834).

Coccus fectucæ Kalt., De Pflanz., p. 747 (1874).

Eriopeltis festucæ Sign., Ann. Soc. Ent. Fr., (5), ix, p. 46 (1879).

Eriopeltis festucæ King, Can. Ent., xxxiii, p. 197 (1901).

Eriopeltis festucæ Butler, "Knowledge," p. 148 (1894).

Eriopeltis festucæ Fletcher, Rep. Can. Exp. Farms, p. 146 (1896).

Habitat.—Europe; Nova Scotia; Canada; Illinois; Indiana; Dakota.

On Festuca cæpitosa; F. phœnicioides.

3. ERIOPELTIS LICHTENSTEINII Sign.

Eriopeltis festucæ Sign. (non Fonsc.) Ann. Soc. Ent. Fr., (5), i, p. 430 (1871).

Eriopeltis lichtensteinii Sign., Ann. Soc. Ent. Fr., (5), vi, p. 607 (1876).

Eriopeltis lichtensteinii Sign., Bull. Soc. Ent. Fr., (5), vii, p. xxxvi (1877).

Eriopeltis festucæ Sign., Bull. Soc. Ent. Fr., (5), vii, p. xxxvi (1877).

Eriopeltis festucæ Bignell, The Entom., xviii, p. 286 (1885).

Eriopeltis lichtensteinii Dougl., Ent. Mon. Mag., xxiv, p. 166 (1887).

Eriopeltis lichtensteinii Newst., Ent. Mon. Mag., xxvii, p. 165 (1891).

Habitat.—France; Holland; England; Scotland.

On Festuca spp. and other grasses.

EXPLANATION OF PLATES.

Cottony Grass Scale. *Eriopeltis festucæ* (Fonsc.).

Figure 1. Egg sacs on Red-top.

" 2. Upper surface of June-grass blade. Enlarged. Showing the number and position of young scales on May 10, 1905, twelve days after the active larvæ were liberated in greenhouse.

" 3. Under surface of same blade on same date.

" 4. Active larva x 120. Ventral view. Showing normal insect appendages.

" 5. Young scale x 44. Ventral view. Scale taken August 17, 1904. Showing atrophied condition of antennæ and legs.

" 6. Egg x 80.

" 7. Full grown female scale. Natural size. Removed from sac before any eggs were deposited.

" 8. Pupa of male scale x 55. Taken August 17, 1904.

Fig. 1.

Fig. 2.

Fig. 3.

STRAWBERRY CROWN GIRDLER. *Otiorhynchus ovatus,* Linn.

EDITH M. PATCH.

More than a little annoyance has been caused in the State by the strawberry crown girdler, a small, black, snout beetle, noticed in some localities especially for its habit of crowding into the house.

It was the protests of tried housekeepers that drew attention to the beetle last season. "We have been overrun with these hateful pests." "I killed more than 400 one evening in the front room." "They travel all over the house and crawl from baseboard to ceiling only to drop to the carpet and try it over and over again. They hide under any protection, carpet, clothing, bedding, and are a general nuisance." Such reports came from Maysville Center, Houlton, Monson, North Wayne and Caribou during September, June and August. They seemed worthy of some attention and this season observations of the strawberry crown girdler were made with reference to the habit of crowding into houses, habits of larva and adult, and remedial or protective measures.

The beetles in the house with reference to their out-of- door habits. The troublesome habit this beetle has of crowding into the house and getting into the way makes it an objectionable insect, although it does no real harm indoors. It feeds upon plants and is therefore, unlike the larder and carpet beetles, interested neither in the food supply of the household nor in clothing and carpets. For the past two years the beetles have occurred in great numbers about the first of June, lasting through that month, and have appeared again in August and September. The house which seems to be troubled most at North Wayne was built in 1822, and as might be expected had crevices near the foundation which offer attractions for insects in search of a hiding place. The beetles were most numerous

in the front room into which they crept through cracks near the base boards, though they entered the house also at the doorway under the screen. If they were content to be quiet after once finding a hiding place, their presence would be less objectionable, often unsuspected indeed, but their exasperating persistence in "climbing over everything only to drop into everything else" as one housekeeper complained, entitles them to the rank of household pests.

The house at North Wayne was not visited until June 27, 1905, and at this time the beetles were not numerous enough to give sufficient data as to the relation of their house infesting habits to their out-of-door movements. Farther north, however, near Houlton July 5, ample opportunity for observation was afforded. A day's search was made for the adult beetles out of doors. They were not found hiding under planks, stones or other objects in damp places, but in dry soil they were frequently dug up from among the roots of plants. Some of these were newly transformed from the pupal condition and would naturally be found under the surface where the larval period was passed, but others were well hardened specimens which seemed to have sought the roots from above ground, very likely for the deposition of eggs.

Toward the top of a hill along a hot, dusty road more of the beetles were found during the day than elsewhere. The road was bordered by white clover, which may have been significant, for larvæ of the beetles were found at the roots of this plant. The puzzling thing about the beetles here was the fact that they (ordinarily more active during the evening) were wandering restlessly across the road at mid day, under a scorching sun which they were evidently glad to avoid, for every time a leaf or chip was placed near these wanderers they crept underneath and remained there. The question why, if they wanted shelter, they had not apparently found it before mid day, was unsolved until a horse and carriage passed, scattering dry layers of clay with which the road was well supplied at this place. Then disturbed beetles were seen everywhere poking out from crumbled clay bits and walking off in search of another nook in which to finish their nap. More than 200 beetles were captured easily after this disturbance before they had found satisfactory

hiding places. Except when the beetles were moving it was difficult to see them, for though they are black they were too thoroughly dust covered to be detected readily in the roadway.

Toward dusk the hill top road was again visited and this time the beetles were more numerous and more interested in their journey, for they had voluntarily quitted shelter, and were out for purposes of their own. Before dark, beetles were seen everywhere along places where they had been sought in vain during the day; fence rails, piles of sun heated stones, tree trunks, sides of sheds, came in for their share of the active beetles as well as doorway and window sill by which the creatures were entering the house.

These out-of-door observations lead logically enough, it seems, to the conclusion that the house seeking habit of the strawberry crown girdler is merely an incident in the general trend of the movements of this beetle,—perhaps accident would be a more appropriate term from the beetle's standpoint for the house proves a gigantic trap from which the beetles, in spite of restless and persistent climbing, find no means of egress. Like the old fashioned wire fly traps, the house is easier to enter from the foundation than to get out of at the ceiling. The beetles desire a dry shelter and find a building as acceptable as a clump of clay,—until they try to get out.

The restless wanderings of these beetles in and out of the house is probably a necessary impulse for the spread of the species for, unlike many insects, they are incapable of flight and are doomed to walk the earth if the succeeding generations are to find new feeding grounds.

It may not be entirely without interest to question whether the presence of these beetles in houses is augmented by lights as is frequently the case with insects most active at night. At North Wayne the room most troubled was the closed front room where no lights were taken during the evening except for a little while to collect the beetles. Yet in one evening over 400 were killed in this room.

The foregoing discussion has a bearing upon two characteristics commonly accredited this beetle. It is spoken of as "gregarious," and its entrance into houses has been explained as "hibernating."

Certainly these beetles were not observed to show gregarious instincts in the sense of seeking the companionship of others of their kind, but wander about quite indifferent to the direction or destination of their kindred Of course in places of concentrated local infestation many beetles independently happen upon the same shelter.

If the beetles were found in houses only in the fall their presence might seem a hibernation, but in Maine there are two times when they appear most abundantly,—during June and in August and September, and the June lot are as troublesome in the house as the fall beetles. These two marked periods might seem to indicate two annual broods, but it is difficult to obtain dependable evidence with an insect which is to be found as adults, pupæ and larvæ of various sizes, from early June until fall, as is the case with this beetle in Maine.

Feeding habits of larvæ. At North Wayne, late in June, a day was spent in search of larvæ of the strawberry crown girdler. Close to the foundation of the house near the room most troubled by the adults, the roots of a grass, *Poa cerotine,* were found to be freely infested by nearly grown larvæ, and this grass had doubtless supplied a fair proportion of the troublesome beetles. A few pupæ and some newly developed adults, still brown in color, were found among the roots with the larvæ. The main seat of action, however, seemed to be the strawberry bed. The weather had been wet and cold for some time, but in spite of that there were conspicuous wilty places in the bed, here and there. The strawberry plants in these spots could be lifted from the ground with the slightest pull, for their roots were eaten through at a distance of two or three inches from the crown. The appropriateness of the popular name of this beetle was thus approved for the strawberry crowns in this bed were certainly "girdled."

A space containing three square feet was selected at random from one of the wilted places in the bed. More than 200 nearly grown grubs, pupæ, and freshly developed adults of the girdler were found about the strawberry roots in this space, besides which there were one young cut worm and four Lachnosterna grubs under half size. How many more there would have been if eight fat predaceous ground beetles had not been skirmishing

through these three square feet of infested soil is a question, depending for its solution upon the capacity of the beetles. It was not surprising to learn, one month later (July 28) that this strawberry bed was more than half dead.

Near Houlton on the place where the beetles were most annoying there was no strawberry bed, and a day was spent examining the roots of meadow plants, July 6, 1905. Larvæ and pupæ of the girdler were found at the roots of wild strawberry, Timothy grass, June grass and white clover. Large potato fields were close at hand, but no signs of the crown girdler were found about potato vines which were dug up in various places in the field.

Feeding experiments with adult beetles. Several hundred beetles taken near Houlton early in July were brought to the laboratory for the purpose of testing the range of their food plants. These were confined for three days at a time in bottles containing perfect leaves. The following list records such leaves (or flowers as indicated) as were found to be eaten to a greater or less extent during this time: Apple, cauliflower, red clover (blossom), red clover, woodbine, Tartarian honeysuckle, turnip, radish, white clover (blossom), white clover, rose (petal), oak, dandelion, lettuce, maple leaf, lawn grass, sorrel, timothy grass, basswood, raspberry, mulberry, spirea, currant, strawberry, rose, plantain, celery, mountain ash, Roman wormwood, rhubarb, bean, nasturtium, wolf weed, nightshade, box elder, thistle, cottonwood, elm, geranium, flowering currant, dahlia, syringa, peony, blackberry, fall dandelion, asparagus, horse radish, pea, chickweed, wild cherry, gooseberry, birch, iris, willow, "self heal."

While it is probable that beetles placed in confinement would eat some leaves which in the open they would avoid for other food, still the foregoing test bears out the reputation of this insect as a general feeder.

REMEDIAL MEASURES.

Arsenate of lead. Two experiments were made with elm leaves (a favorite diet of the girdler) dipped in arsenate of lead, mixed at the rate of 4 pounds to 50 gallons of water. For the first, 42 well fed beetles were confined with a few poisoned leaves for two days, when 18 were dead and 24 still alive. For the second

test 40 beetles were kept without food for 7 days and then confined for 36 hours with poisoned elm leaves. At the end of this time 32 beetles were dead and 8 alive. These tests, especially the second, were arbitrary and unfair with respect to normal out-of-doors conditions because ordinarily the beetles would not be so hungry and there would be unsprayed food within traveling distance. The only significant fact concerned is if they eat sprayed plants they die. In this connection the experience in Montana * with new strawberry plants dipped in arsenate of lead is exceedingly interesting. It was found in that instance that the beetles avoided the sprayed leaves and began to feed upon the roots of the strawberry.

In view of the great range of food plants accepted by the adult beetles there seems little help to be expected from the application of poison except as it might serve to a certain extent as a protection of valuable plants by causing the beetles to shun them. Mr. R. A. Cooley * concluded that where adult beetles attacked the leaves badly, spraying was better than no treatment and was worth the cost and trouble incurred. The injury to strawberry beds in Maine, however, has been (so far as known) by the grubs alone, working at the roots, and thus spraying, here, would be of no avail.

Cultural means. The fact that grubs (larvæ) of the crown girdler were found during the past season at the roots of grasses, white clover, and wild strawberry merely confirms the evidence of other observers that the larva of this insect finds its natural food in roots of grasses and other meadow plants. Young strawberries set out on newly broken ground already infested with these grubs would of necessity be seriously attacked.

Mr. R. A. Cooley says * in this connection, "The remedial measure that seems to promise most is so managing the soil that when it is desired to set out the field to strawberries the beetles will have been previously starved out." He also cites the case of a Montana fruit grower who was so troubled by this insect that he abandoned strawberry growing entirely some years ago, using the land for other crops. Strawberry plants were started on this same place in the summer of 1904 and were not troubled at all by these beetles.

* Montana Agr. Exp. Sta., Bul. 55.

This method is in accordance with preventive means commonly accepted as the only practical way of combating other underground enemies, such as the white grub and the wire worm.

No extended tests have been made in Maine as to what crops would be best adapted for this purpose. At Houlton, however, favorable opportunities for an observation were offered. Potato fields were at hand on newly broken ground adjoining meadows freely infested with grubs of the crown girdler. In two of these fields, the roots of potato vines variously situated were examined and in no case were larvæ of the crown girdler found. This, of course, is no positive indication that potato vines are never attacked by this insect, but the situation of the potato field was exactly such as would have proven the worst possible condition for a strawberry bed; and the apparent freedom of the field from the grubs certainly seems significant.

In localities where the strawberry crown girdler is present to any marked extent, it would be unsafe to set strawberry plants in newly broken land. Some less susceptible crop (the potato would probably serve) should be used first, and the soil so thoroughly cultivated that grass or other weeds cannot remain as a bait for the beetles, or food for such larvæ as chance to be already in the ground.

Repellents. As most of the complaints against this beetle in Maine were concerned with its entrance to houses, a few tests were made to see if camphor gum could be used successfully as a repellent to be placed at cracks about baseboards or windows. Between 30 and 40 beetles were placed in a space 6 inches in diameter surrounded by a circle of powdered camphor gum piled about an inch high. The beetles seemed neither stunned nor excited, but walked about in the space and climbed over the camphor apparently indifferently for quarter of an hour when the beetles were taken and buried under a mound of the camphor gum and left for nearly two hours. Shortly after the camphor was removed, the beetles, deliberately stalked off, to all appearances as well as ever. The experiment was repeated with flowers of sulphur with precisely the same results.

At Maysville Center where the beetles in troublesome numbers were entering a house under the baseboard, a liberal application of fresh pyrethrum powder was recommended. The report

came "They do not seem affected one bit by insects powder. They walk right through it and do not mind it at all."

Probably all that can be done to guard against an invasion of the house is to stop the cracks with putty as far as possible and then philosophically to regard these beetles that get in as really harmless. It may be, too, that the beetles will not occur for many years in succesSsion in such large numbers in the places of worst infestation. At North Wayne about 18 years ago there was an outbreak of the same pest which overrun the house for two or three seasons, after which the trouble disappeared, not to come again in conspicuous numbers until the last few years. What natural agencies controlled the situation are quite a matter for surmise.

SUMMARY.

Out of doors. The strawberry crown girdler in the larval or grub stage feeds upon the roots of grasses and some other plants. Strawberries are especially susceptible to attack and should not be set in, or very near, soil infested by these grubs. The only known practical remedy is clean cultivation. The adult beetles feed upon the leaves of the strawberry and many other plants, and when they are numerous enough to cause much injury, arsenate of lead should be used as a spray.

In the house. The presence of great numbers of the beetles in the house is annoying but need cause no real alarm, for they are bent upon no mischief either to persons, clothing or food supplies. Ordinary repellents seem to be or no avail, and probably all that can be done to guard against them is to make the house as tight and beetle proof as possible. With this precaution such beetles as can not be conveniently swept or gathered up, can be tolerated as harmless and transient guests.

INSECTS OF THE YEAR.

EDITH M. PATCH.

Tussock moth. Cocoons of two species of tussock moth, *Notolophus leucostigma* and *N. antiqua,* were received in such numbers during the present year that it is simpler to give them single mention than to list each specimen sent for identification. Most of these cocoons were accompanied by the question "Is this the nest of the brown-tail moth?" In order that further confusion may be avoided to some extent at least, figures 14 and 15 are presented with this comment: The winter nests of the brown-tail moth contain many tiny caterpillars, while the cocoons of the tussock moth are empty during the winter and those from which the females have emerged are covered by a mass of whitish eggs. These egg clusters should be collected and burned.

Red-humped catapillars. There were talso too many of the red-humped caterpillars, *Œdemasia concinna,* to list in the accompanying table. Between July 29 and October 28, 1905, 81 lots of these caterpillars were received for identification. As only 11 came last year, these insects seem to be on the increase at present. They undoubtedly did great damage in the State this season. Many orchardists reported that entire orchards of young trees were stripped of their foliage, except for the mid ribs of the leaves, before the presence of the pest had been discovered. They are not especially difficult to combat as the broods are gregarious and if found while the caterpillars are young the whole colony can usually be removed with ease. The fact that they come late in the season makes their attacks a surprise oftentimes. Arsenical sprays will kill them, but the presence of ripe fruit sometimes debars the use of poison. There is no difficulty in recognizing this peculiar caterpillar by its red head and conspicuous red band about the body a short distance behind the head. See figure 16.

The yellow-necked caterpillar, *Datana ministra,* seems also to be increasing in this State. During August this species vied with the preceding in troubling orchardists. Means of combating these two species are identical. See figure 19.

Tent caterpillars. The unsightly webs of the tent caterpillar, *Clisiocampa americana,* which had not been numerous for several seasons, were present to a troublesome extent all over the State this spring.

Stalk borer. In July and August the stalk borer, *Papaipema nitella,* caused complaint from several localities. The destruction of a crop of sweet corn for two seasons was charged to its account near Gardiner. From Westbrook five specimens of this caterpillar were received with the report: "This pest is destroying my raspberry, blackberry, currant, and gooseberry bushes, corn and dahlia stalks, potato vines and many other kinds of plants, by boring a hole into the plant, usually near the ground but sometimes as many as 30 inches above the surface of the ground, and then eating its way, usually up but sometimes down, until the plant is destroyed."

Cherry tortrix. An interesting communication from North Newry late in June gave a description of a "yellowish worm one and a quarter inches long, present by thousands in the grass in the meadow." The owner of the meadow feared a "new grass pest." When specimens were asked for, a mass of grass was sent which was webbed solidly together, and writhing with larvæ of the cherry tortrix, *Cacœcia cerasivorana.* They were not eating the grass and further inquiry elicited the information that they had stripped some wild cherry bushes on the meadow border and then had webbed the grass far into the meadow. About 9 cubic inches of the web was saved and the larvæ pupated, packing it full of pupal cells. On July 10, 119 fresh looking pupæ were counted in this section. During the next few days many moths and a few ichneumons emerged. Brown egg masses were deposited in thin, well varnished layers on the sides of the glass jars and upon leaves, by the imprisoned moths.

Mourning cloak. Larvæ of the mourning cloak butterfly, *Euvanessa antiopa,* were reported in destructive numbers from several localities upon elm, willow and apple. Fully half of the caterpillars received at the Station (about 200) were parasited by tachina flies. See figure 20.

Dotted geometer. Late in the summer larvæ of the chain dotted geometer, *Cingilia catenaria,* were plentiful upon sweet fern, and large swarms of these beautiful, smoky winged moths were common during the cool autumn days and evenings near Orono and Alfred. See figure 17.

Snout beetle. At North Wayne in June an interesting looking bronze gray snout beetle was found in and about a house frequented by the strawberry crown girdler. More of this species were reported from North Wayne during September and one of the specimens was sent Dr. L. O. Howard, chief of the Bureau of Entomology, United States Department of Agriculture, for identification. Dr. Howard kindly replied that the specimen "was identified by Mr. E. A. Schwarz as *Sciaphilus muricatus,* Fab. This species is now referred to *asperatus.* A brief note on its occurrence in Maine with reference to other occurrences in this country is given on p. 272 of vol. VII of Insect Life. It is an introduced species, and some doubt has been expressed by Mr. Schwarz as to its permanent location in this country."

The reference to Insect Life reads as follows:

"During September of the present year a correspondent at Bangor, Me., sent to this office a small lot of a European snout beetle, *Sciaphilus asperatus* Bonsd. (*muricatus* Fab.), which has attracted some little attention in that city. Our correspondent informs us that the beetles gather on the fences, and 'getting on the top rail just cluster and keeping still seem to enjoy life.' They have a singular habit of 'piling up on each other in a straight line, many at once and in many small groups.' They were not, however, observed to be copulating. This unusual gathering took place during the first of September and was preparatory to hibernation.

"The first notice of the occurrence of this insect in North America is by Mr. Samuel Henshaw, published in 1888 in Psyche (vol. V, p. 137). The insect was collected at Brookline, Mass., by Mr. F. C. Bowditch, on *Populus balsamifera.* In the Canadian Entomologist (vol. XXIII, pp. 23, 114, 1891) Mr. W. H. Harrington reports this species at Sydney, Cape Breton, Nova Scotia. It was found in 1884 and 1890 and was not uncommon. In the National Museum collection there are also specimens from Malden and one other locality in Massa-

chusetts, and Mr. M. L. Linell informs me that he has taken a specimen near Brooklyn, L. I.

"It will be noticed that although the species was known to have been introduced at least ten years ago, that it is still limited to districts near the seashore. Like other allied wingless species that have been introduced from Europe it will probably not extend its range much farther south, but will move gradually westward from the points where it has now established itself. It is a common European species and is known to feed on a great variety of deciduous trees and shrubs, and though it is impossible to forecast the future it is not probable that it will ever be particularly injurious to cultivated plants in this country.—F. H. C."

As the foregoing account was written some ten years ago, data concerning this season's collection in Maine may be of interest.

On June 20, 1905, a correspondent wrote a vigorous protest against beetles in her house and stated "there are two kinds of bugs, but more of the black than the gray ones." Both kinds were reported to have been very numerous for two years in June and again in the fall. Specimens accompanied the letter and the black ones proved to be the strawberry crown girdler, while the gray ones were the species recently identified by Mr. Schwarz as *Sciaphilus asperatus* Bonsd. (*muricatus* Fab.)

At North Wayne on June 27 seven of this species were collected at dusk climbing the foundation of the house and a few more were taken inside the dwelling.

Between 20 and 30 of these beetles were collected by the North Wayne correspondent September 11, and sent to the Station with the information: "I found all I send on my dahlia blossoms. There are none in the house now but I find them out of doors on 'most everything though not very thick."

It would seem that this imported snout beetle has not yet lost its hold. No other specimens of *Sciaphilus asperatus* are recorded at the Station this season, except a single specimen collected at Orono, August 8, 1905.

Rose chafer. On June 28, the vicinity of North Wayne and Kent's Hill was observed to be invaded by the rose chafer, *Macrodactylus subspinosus.* Willows and alders had been eaten to the greatest extent, though wild blackberry bushes were

stripped here and there. The rose bushes did not happen to be attacked badly at that date. One alder clump composed of five stems none of which was six feet high presented a peculiar appearance with every leaf skeletonized and dangling with pairing beetles. From this single clump 1,315 chafers were collected and then the task of clearing the bush was abandoned as hopeless. Twenty leaves were then picked at random and from one to three pairs of chafers were still clinging to each.

About this time specimens of the rose chafer were received from Mt. Vernon with the complaint that some of the orchard trees were covered with them. Several apples about one inch in diameter, accompanying this communication, were tunnelled to the core by the chafers which were gorged and sticky with the repast. See figure 21.

A report from West Peru stated that a whole orchard had been stripped. Early in July from East Sumner a correspondent wrote that for three years the rose chafer had done great damage to orchards, berry bushes and gardens, "about ruining everything they touch."

Carpet beetle. Early in June carpet beetles, *Anthrenus scrophularius*, were seen commonly upon rhubarb and horse radish blossoms at Orono. June 9, they seemed especially numerous and a half day's collection was made from one rhubarb bed during which time 156 of these beetles were taken. As they were also on polliniferous flowers which are gathered for house decoration, it is advisable to be on the watch for these beetles in picking flowers in order to make sure that none are carried into the house in this way. The adult beetles are pollen eaters but the young, as is known well enough, are among the most troublesome of household pests.

Flea beetle. About June 6, several species of flea beetles were much in evidence at Orono. The cucumber flea beetle, *Epitrix cucumeris*, had riddled the leaves of potato vines. A striped flea beetle, *Phyllotreta vittata*, was present especially on horse radish, and bronze flea beetles were conspicuous upon rhubarb and other plants.

Wire worms. As the present season brought an unusual number of complaints against wire worms, the following statements in regard to these insects were published as a newspaper bulletin.

Wireworms are slender grubs of yellowish white color and very hard bodies. They are the young (larvæ) of click-beetles, or snapping beetles, so called from the fact that when placed upon their backs they will suddenly bend the body and, with a sharp clicking sound, throw themselves a considerable distance into the air. They are among the most troublesome of crop pests and as they live underground it is difficult to combat them.

At the New York, Cornell, Agricultural Experiment Station, exhaustive experiments covering a period of three years were made for the purpose of testing remedial measures. The statements here made are based largely upon the results of those experiments. Many methods that had previously been recommended for the destruction of these pests were found to be inefficient. To cite but one example: It was found that the wire worms were still alive in soil to which salt enough had been applied to kill the vegetation.

One method, especially approved, was fall plowing. The explanation of the beneficial results that follow fall plowing is believed to be found in the following facts. Wire worms live for at least three years in the worm or larval state. When the worms are full grown they change to soft white pupæ during July. The pupal stage lasts only about three weeks, the insect assuming the adult form in August. But, strange to say, although the adult state is reached at this time, the insect remains in the cell in the ground till the following April or May, nearly a year. This period of quiescence is apparently necessary to the life of the beetle, for in every case where the soil was disturbed after the insects had transformed, the beetles perished. By fall plowing we can destroy the beetles in the soil and thus prevent their depositing eggs the following season. After plowing (at least six inches deep) the soil should be well pulverized and kept stirred so that the earthen cells of the pupæ and adults may be destroyed. It will usually require at least three years to render the soil comparatively free from wire worms, as only the pupæ and adults are killed, the young larvæ remaining uninjured.

Nematode worm. Late in November specimens of diseased gardenia from one of the nurseries in the State were received at this Station. The trouble seemed to be caused neither by insect or fungus attack and the material was sent to the United States

Department of Agriculture, Bureau of Plant Industry, for examination. Mr. C. O. Townsend, acting pathologist and physiologist of that bureau, stated the trouble to be due to nematode worms.

Although worms are not insects, the nature of their attack and the remedies applied bring them into a closer relation with work pertaining to insects than any other department of the Station, and a record of this case is included with notes on insects.

As Mr. Townsend's letter is of interest and as the preventative means he recommended apply with equal force to millipedes, concerning which complaints from greenhouses frequently reach the station, the letter is quoted in full:

"The swellings on the roots were caused by the root-knot nematode, *Heterodera radicicola*. These swellings, after the nematodes have reached maturity and laid their eggs, decay and bring about thus the death of the plant. They also reduce the vigor of the plant before the period of decay is reached by checking the water supply and diminishing the root growth.

"There is no certain method known by which the nematodes can be killed in the roots of this plant without injury to the plant itself. Experiments were conducted at Washington some years ago with roses badly infested with nematodes, using a 1-per cent solution of formalin. This proved effective in destroying the pests and, although it caused the shedding of the leaves, did not kill the rose plants. Whether similar treatment would be destructive to the gardenia plants or not can be determined only by experiment. The plants should be hardened off somewhat for a week or two before the experiment is made.

"The trouble can be avoided by sterilizing the soil in which the plants are to grow and then using only such plants as are absolutely free from any signs of root-knot. This sterilization can best be effected, as described in bulletin No. 55 of the Hatch Experiment Station, by the use of live steam from a boiler with a pressure of 40 to 60 pounds. This is conducted through perforated pipes laid in the bottoms of the benches, the steam being passed into the soil until it has all been heated to the temperature of boiling water. This suffices to kill not only the nematodes but also various destructive fungi."

Tarnished plant bug. The tarnished plant bug was present in the usual numbers this season and during the spring caused

considerable injury to opening leaf and flower buds by puncturing the buds, which resulted in deformed growth.

Plant lice. Serious injuries were caused by plant lice in different parts of the State. Perhaps the most important of these this season were injuries to cucumber vines, several beds being entirely ruined. Where the plants were small enough, however, to cover, bisulphide of carbon was recommended and this treatment met with entire success. It is not a difficult remedy to apply and the gardeners who used it were pleased with the results.

For the past two seasons enormous numbers of plant lice have appeared upon the potato vines near Houlton, working both on the stalks and on the under side of the flower leaves.

As usual where plant lice are numerous, complaints against ants and lady beetles are frequent. "Ants have attacked our woodbine and caused the leaves to wilt," and specimens of lady beetles sent in with the report "these are completely devastating cucumber patches," or "ruining a small ash tree," are examples of this all too common mistake. When ants are seen running over plants it is usually for the purpose of sipping a sweet fluid exuded by the plant lice and not to injure the plant. It is especially unfortunate that larval lady beetles are not more generally recognized, because they are among the most active of the natural checks upon plant lice, devouring great numbers of them.

Nearly 80 collections of plant lice were made during the summer, most of them near Orono. It was interesting to notice that though this family of insects was everywhere abundant the past two seasons the species most common in 1904 were not so much in evidence in 1905 as different species. A fuller and more definite record of this material is reserved for future discussion.

The natural checks which seemed to be most effective in connection with the observed species of plant lice, were Syrphus flies, lady beetles, predaceous Capsidæ, and parasites of the genus *Aphidius*.

Garden flea. At the time garden plants were just starting, about the first of June, garden fleas, *Smynthurus albamaculata* Harvey, were to all appearances guilty of real havoc in Orono gardens. Myriads of the tiny creatures occurred on the tender

young leaves of lettuce, beans, cucumbers and squash and other plants which were at the time quite free from other insect guests. They worked round cavities in the soft leaves (usually from the under side, but not infrequently from the upper) reaching into the soft tissues, but not piercing quite through both surfaces of the leaf. The plants attacked were much damaged.

Apple maggot. There seems little to be said about the apple maggot for 1905 except that there is no apparent change in the general situation. It is at least not increasing in extent of injury in Maine.

Brown-tail moth. By far the most serious insect problem for Maine at present is the brown-tail moth. An account of this destructive and distressing pest was published last year.* A discussion of the moth and a history of the campaign against it has recently been ably presented in Bulletin of the Department of Agriculture of Maine, Vol. IV, No. 4, as a report of Hon. A. W. Gilman, Commissioner of Agriculture, and Mr. E. F. Hitchings, Entomologist. It hardly seems necessary here, therefore, to do more than touch upon the work of this Experiment Station in connection with the situation. Previous to the State appropriation for protection against insect ravages, the State Pomological Society expressed a helpful interest in the matter, and the Experiment Station worked in co-operation with the Commissioner of Agriculture in ascertaining the extent of infestation. This co-operation was continued during the spring of 1905, the Station locating infested areas in the counties of York, Cumberland, Androscoggin, Sagadahoc, Kennebec, Lincoln, Knox, Waldo, and Hancock. Station bulletins and other printed matter concerning the brown-tail moth and the danger involved were scattered broadcast over the State.

Whenever the infestation was discovered, the town or local authorities earnestly used every means within their power to inform the people of the danger and incite them to the destruction of the nests. So thoroughly was the work done that for the season just over, no appreciable loss has been experienced in Maine from the brown-tail moth and only a few cases of poisoning have been reported. It is not to be understood, however, that anything approaching an extermination has taken place. Scattered nests in wild growths remained to form new centers

* Me. Exp. Sta., Bul. 108.

of infestation and alarming invasions of the winged moths from neighboring states occurred during the past summer. This year, no less than last, Maine is confronted with a serious menace to the orchard and woodlands, to the attraction of summer resorts, and to the health and comfort of the people; and the neglect of the situation now means a gigantic financial problem for later years to meet.

Insect legislation. Until 1905 no state appropriations had been made in Maine to provide for the protection of trees and shrubs from the introduction and ravages of dangerous insects and diseases. The alarming invasion of the brown-tail moth during 1903 and 1904 emphasized the need of legislation relating to such matters, and on February 28, 1905, a protection act was passed. This act provides for the inspection of nurseries in the State and of nursery stock shipped into the State, by a competent entomologist to be employed by the Commissioner of Agriculture; and places with the Commissioner of Agriculture the duty of making full investigations of any locality when the presence of the brown-tail or gypsy moths or other injurious insects or plant diseases may be suspected.

A copy of this act may be procured by applying to the Commissioner of Agriculture, Augusta, Me., in whose hands the matter rests.

LIST OF INSECTS RECEIVED.

A partial list of the insects received at this Station for identification from January 1 to December 1, 1905, is given on the following pages.

INSECTS RECEIVED FOR IDENTIFICATION.

Name.	Date.	Host.	Locality.	Remarks.
Fuller's rose beetle, *Aramiges fulleri*	Jan. 17	Tuberous begonia	Ellsworth	Larvæ troublesome in greenhouse.
———, *Chrysomela multiguttata*	May 25	Linden	Portland	Adults numerous.
———, *Serica sericea*	June 8	Strawberry	Indian River	Adults devouring the leaves, numerous.
Strawberry crown girdler, *Otiorhynchus ovatus*	June 22		Wayne	Great numbers in house.
Strawberry crown girdler, *Otiorhynchus ovatus*	June 29		Caribou	Great numbers in house.
Strawberry crown girdler, *Otiorhynchus ovatus*	June 29		Maysville Centre	Great numbers in house.
Strawberry crown girdler, *Otiorhynchus ovatus*	June 29		Monson	Great numbers in house.
Rose chafer, *Macrodactylus subspinosus*	July 1	Apple plum	West Peru	Stripped the orchard.
Rose chafer, *Macrodactylus subspinosus*	July 3	Blackberry, elm and others	East Sumner	Very troublesome.
Rose chafer, *Macrodactylus subspinosus*	June 29	Apples	Mt. Vernon	Apples eaten to the core.
Lady beetles, ———	July 14		Belfast	Larvæ numerous on ash, feeding on plant lice.
Lady beetle, ———	Aug. 23		Portland	Larvæ feeding on plant lice on poppy.
Lady beetle, *Coccinella 5-notata*	Aug. 3		Lewiston	Numerous on cucumber vines.
Saw-toothed grain beetle, *Silvanus surinamensis*	July 14	Flour and starch	Richmond.	
Tortoise beetle, *Chelymorpha argus*	July 17		Lisbon Falls	Larvæ.
Tortoise beetle, *Chelymorpha argus*	Aug. 3	Raspberry	Stroudwater	Pupæ and adults numerous.
———, *Chrysochus auratus*	July 22	Dogbane	Bethel.	
Bean weevil, *Bruchus obtectus*	Aug. 28		Searsport.	
———, *Monohammus titillator*	Aug. 30		Winnegance	Adult.
White pine weevil, *Pissoides strobi*	Sept. 6	Pine	Bar Harbor	Destroying leading shoot.
Round-headed apple tree borer, *Saperda candida*	Sept. 23	Apple	Solon	Adult reported to be feeding on apple leaves.
Bumble flower-beetle, *Euphoria inda*	Oct. 9	Apple	South Bridgton	Adults destroyed about 100 grafts in apple trees.
Wire worms, ———	Nov. 8	Potato	Newport	Larvæ very troublesome.
Wire worms, ———	Oct. 24	Potato	Clinton	Larvæ very troublesome.
Wire worms, ———	May 18	Onion	Lee	Larvæ very troublesome.
Eyed elater, *Alaus oculatus*	June 29		Corinna	Adult.
Leaf-rolling weevil, *Attelabus sp.*	Aug. 8	Alder	Gardiner	Packets on leaf.
———, *Sciaphilus asperatus*	June 20		North Wayne	Adults in house.
———, *Sciaphilus asperatus*	Sept. 11	Dahlia	North Wayne	Adults in blossoms.
Brown-tail moth, *Euproctis chrysorrhœa*	Feb. 23		South Berwick	Nests numerous.
Brown-tail moth, *Euproctis chrysorrhœa*	Feb. 27		Bowdoin	Nest.
Brown-tail moth, *Euproctis chrysorrhœa*	Feb. 28	Apple	Portland	Nests.
Brown-tail moth, *Euproctis chrysorrhœa*	March 4		Lincolnville	Nest.
Brown-tail moth, *Euproctis chrysorrhœa*	March 17		Kittery Point	Nests numerous.
Brown-tail moth, *Euproctis chrysorrhœa*	March 20		West Scarboro	Nest.
Brown-tail moth, *Euproctis chrysorrhœa*	April 3	Apple, plum, birch	Vinalhaven	Nests in great numbers.

INSECTS RECEIVED FOR IDENTIFICATION—CONTINUED.

Name.	Date.	Host.	Locality.	Remarks.
Brown-tail moth, *Euproctis chrysorrhœa*	May 19	Plum	Maxfield	Nest containing 183 living caterpillars.
Brown-tail moth, *Euproctis chrysorrhœa*	June 1		East Jefferson	Nest.
Brown-tail moth, *Euproctis chrysorrhœa*	July 29		Bar Harbor	Egg mass.
Cherry tree tortrix, *Cacœcia cerasivorana*	June 26	Wild cherry	North Newry	Larvæ webbing grass.
Cherry tree tortrix, *Cacœcia cerasivorana*	July 1	Wild cherry	Palmyra	Larvæ.
Cherry tree tortrix, *Cacœcia cerasivorana*	July 3	Wild cherry	North Monmouth	Larvæ.
Cherry tree tortrix, *Cacœcia cerasivorana*	July 10	Wild cherry	Greenville	Larvæ.
Cherry tree tortrix, *Cacœcia cerasivorana*	July 17		Gardiner	Larvæ.
Stalk borer, *Papaipema nitela*	July 7	Corn	Gardiner	Larvæ ruining corn stalks.
Stalk borer, *Papaipema nitela*	July 7	Strawberry	Sanford	Larvæ buried in fruit. Troublesome.
Stalk borer, *Papaipema nitela*	July 15	Sweet corn	Gardiner	Spoiled sweet corn for two seasons.
Stalk borer, *Papaipema nitela*	July 27	Corn, potato, dahlia	Westbrook	Devastating garden.
Stalk borer, *Papaipema nitela*	Aug. 10	Potato	Portland	Working havoc in stalks.
Thysbe clearwing, *Hemaris thysbe*	July 1		Vinalhaven	Adult.
Galium sphinx, *Deilephila chamœnerii*	July 3		Athens	Adult.
Virginian tiger moth, *Spilosoma virginica*	July 3		Abbot	Adult.
Salt-marsh caterpillar, *Estigmene acræa*	July 3		Winterport	Adult.
Unicorn prominent, *Schizura unicornis*	Sept. 6	Apple	Lisbon Falls	Larvæ.
———, *Sabulodes transversata*	Sept. 12	Apple	Lewiston	Larvæ.
Scallop-shell geometer, *Calocalpe undulata*	Sept. 18		Kezar Falls	Larvæ.
Codling moth, *Carpocapsa pomonella*	March 17		Brooklin	Adult.
Oblique-banded leaf roller, *Cacœcia rosana*	June 13	Apple	Newport	Larvæ in great numbers.
Gray comma, *Grapta progne*	June 16	Currant	Lowell	Larvæ plentiful.
Gray comma, *Grapta progne*	July 15	Gooseberry	Ashland	Parasited larva.
Laurel sphinx, *Sphinx kalmiæ*	June 16		Solon	Adult.
Laurel sphinx, *Sphinx kalmiæ*	June 29		Skowhegan	Adult.
Laurel sphinx, *Sphinx kalmiæ*	July 8		Skowhegan	Adult.
Green apple leaf-tier, *Teras minuta*	June 21	Apple	Houlton	Larvæ.
Canker worm, *Anisopteryx pometaria*	June 21	Apple	Houlton	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	June 24	Elm	Portland	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	July 1		Berwick	Larva.
Mourning cloak butterfly, *Euvanessa antiopa*	July 24	Elm	North Monmouth	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	July 24		Greenville	Parasited larva.
Mourning cloak butterfly, *Euvanessa antiopa*	July 26	Elm	Harrison	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	July 29	Elm	Lee	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	Aug. 3	Balm gilead	Wells	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	Aug. 7	Poplar	North Monmouth	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	Sept. 16		Auburn	Larvæ.

INSECTS RECEIVED FOR IDENTIFICATION—CONTINUED.

Name.	Date.	Host.	Locality.	Remarks.
Apple sphinx, *Sphinx gordius*	Aug. 23	Apple	Lewiston	Larva full grown.
Achemon sphinx, *Philampelus achemon*	Aug. 23	Woodbine	Waterville	Larva.
Promethea moth, *Callosamia promethea*	Feb. 18		Kennebunkport	Cocoons, common
Cecropia moth, *Samia cecropia*	March 17		South Paris	Cocoon.
Cecropia moth, *Samia cecropia*	April 10		Greene	Cocoons.
Cecropia moth, *Samia cecropia*	April 17	Apple	Jay	Cocoon.
Cecropia moth, *Samia cecropia*	April 18	Pear	Wiscasset	Cocoon.
Cecropia moth, *Samia cecropia*	May 1		Ripley	Cocoon.
Cecropia moth, *Samia cecropia*	May 6		Skowhegan	Cocoon.
Cecropia moth, *Samia cecropia*	May 19		Abbot	Cocoon.
Cecropia moth, *Samia cecropia*	June 21		North Anson	Cocoon.
Cecropia moth, *Samia cecropia*	July 3		Detroit	Male.
Cecropia moth, *Samia cecropia*	July 26	Apple	Harrison	Cocoon.
Cecropia moth, *Samia cecropia*	Aug. 16		Har Harbor	Larva full grown.
Cecropia moth, *Samia cecropia*	Aug. 25		Newport	Larva full grown.
Cecropia moth, *Samia cecropia*	Oct. 16		Dryden	Cocoon.
Cecropia moth, *Samia cecropia*	Oct. 19		Buckfield	Cocoon.
Swallow-tail butterfly, *Papilio polyxenes*	March 3		South Paris	Chrysalis.
Swallow-tail butterfly, *Papilio polyxenes*	July 7	Parsnip	Brunswick	Larva.
Tiger swallow-tail, *Papilio turnus*	Aug. 18	Apple	Belgrade Lakes	Larva.
Tiger swallow-tail, *Papilio turnus*	Sept. 1		Hutchins	Larva.
Tiger swallow-tail, *Papilio turnus*	Aug. 15	Apple	Dover	Larvæ.
Polyphemus moth, *Telea polyphemus*	May 1		South Paris	Cocoon.
Polyphemus moth, *Telea polyphemus*	July 3		Gardiner	Male.
Polyphemus moth, *Telea polyphemus*	July 13		Olamon	Male.
Polyphemus moth, *Telea polyphemus*	Sept. 13		Gorham	Cocoon.
Tent caterpillar, *Clisiocampa americana*	May 19		North Penobscot	Eggs.
Tent caterpillar, *Clisiocampa americana*	May 31	Apple	Bar Harbor	Nest and larvæ.
Tent caterpillar, *Clisiocampa americana*	June 2	Apple	Mechanic Falls	Old cocoon.
Tent caterpillar, *Clisiocampa americana*	July 24		North Monmouth	Male.
Tent caterpillar, *Clisiocampa americana*	Aug. 21		Foxcroft	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Aug. 22		East Lowell	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Aug. 29		East Holden	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Sept. 1		West Troy	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Sept. 1		Skowhegan	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Sept. 13		Unity	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Oct. 4		Monmouth	Egg cluster.
Hickory tiger moth, *Halisidota caryii*	July 17	Apple	Springvale	Larvæ.

INSECTS RECEIVED FOR IDENTIFICATION—CONTINUED.

Name.	Date.	Host.	Locality.	Remarks.
Hickory tiger moth, *Halisidota caryii*	July 29	Apple	Greene	Larvæ.
Hickory tiger moth, *Halisidota caryii*	Aug. 4	Apple	Charleston	Larvæ.
Hickory tiger moth, *Halisidota caryii*	Aug. 15		Dexter	Larvæ.
Chain-dotted geometer, *Cingilia catenaria*	Aug. 8	Sweet fern	Dayton	Larvæ very numerous.
Chain-dotted geometer, *Cingilia catenaria*	Aug. 15	Sweet fern	Lyman	Larvæ very numerous.
Chain-dotted geometer, *Cingilia catenaria*	Aug. 19	Sweet fern	Alfred	Larvæ very numerous.
Chain-dotted geometer, *Cingilia catenaria*	Oct. 4		Alfred	Moths flying about sweet fern.
Fall web worm, *Hyphantria cunea*	Aug. 8	Apple	Kent's Hill	Larvæ.
Fall web worm, *Hyphantria cunea*	Aug. 15		Kennebunk	Larvæ.
Dagger moth, *Apatela lepuscula*	Aug. 11	Poplar	Dexter	Larvæ.
Skiff slug caterpillar, *Eulimacodes scapha*	Aug. 21	Apple	Foxcroft	Larvæ.
Io moth, *Automeris io*	Aug. 8		West Buxton	Larvæ.
Jo moth, *Automeris io*	Sept. 6		Westbrook	Larvæ, "Pest on delicate garden plants."
Mediterranean flour moth, *Ephestia kuehniella*	Oct. 13		Gardiner	Reared in laboratory.
Thistle butterfly, *Pyrameis cardui*	July 27	Echinops	Bar Harbor	Larvæ troublesome in nursery.
Chersis sphinx, *Hyloicus chersis*	Aug. 7	Ash	Fort Fairfield	Larvæ.
American lappet moth, *Phyllodesma americana*	July 24	Birch	North Monmouth	Larva.
———, *Argynnis cybele*	July 24		North Monmouth	Adult.
Velleda lappet moth, *Tolype velleda*	July 25		Gerry	Larva.
Walnut caterpillar, *Datana angusii*	Aug. 23	Black walnut	South Berwick	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	July 26	Apple	Harrison	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 4	Apple	Eliot	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 4	Apple	Litchfield	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 8	Hazel	Gardiner	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 11	Apple	Mechanic Falls	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 11	Apple	Fairfield	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 11	Apple	South Paris	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 15		Wales	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 21		Litchfield	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 21		Foxcroft	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 22		East Lowell	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 23		Sabattus	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 25		Vassalboro	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 28		Springvale	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 28		Ross Corner	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 30		North Anson	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Sept. 1		Lee	Larvæ.

INSECTS RECEIVED FOR IDENTIFICATION—CONTINUED.

Name.	Date.	Host.	Locality.	Remarks.
Yellow-necked caterpillar, *Datana ministra*	Sept. 1		North Jay	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Sept. 1		Skowhegan	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Sept. 4		East Waterford	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Sept. 6		Sumner	Larvæ.
Scalloped owlet moth, *Scoliopteryx libatrix*	April 5		Augusta	Adult.
White marked tussock moth, *Notolophus leuco stigma**				
Old tussock moth, *Notolophus antiqua*				
Red-humped caterpillars, *Œdemasia concinna**				
Elm leaf curl, *Schizoneura americana*	Feb. 16	Elm	Presque Isle.	
Elm leaf curl, *Schizoneura americana*	March 4	Elm	Alfred.	
Elm leaf curl, *Schizoneura americana*	April 1	Elm	Norridgewock.	
Elm leaf curl, *Schizoneura americana*	June 23	Elm	Gardiner.	
Plant lice, ————	March 20	Asters	Gardiner	On roots; very destructive.
Plant lice, ————	July 1	Cucumbers	West Bath	Vines ruined for two years.
Plant lice, ————	Aug. 18	Cucumber	Portland	Ruining the bed.
Plant lice, ————	Aug. 18	Poppy	Portland.	
Plant lice, ————	Aug. 18	Rhubarb	Portland	Especially troublesome.
Plant lice, ————	Aug. 19	Apple	Newport.	
Plant lice, *Pemphigus rhois*	Sept. 12	Sumach	East Holden	Galls numerous.
Plant lice, *Pemphigus*	Sept. 14		Castine	Numerous on the wing.
Alder blight, *Pemphigus tesselata*	Aug. 21	Alder	South Orrington	Conspicuous infestation.
Apple aphis, *Aphis mali*	Oct. 24	Apple	Kezar Falls	Adults and eggs.
Woolly louse of the apple, *Schizoneura lanigera*	Oct. 13	Apple	South Thomaston.	
————, *Pemphigus acerifolii*	July 13		Alfred	Winged forms, "present by thousands."
————, *Pemphigus acerifolii*	July 14	Maple	Kennebunk	Several localities infested.
————, *Pemphigus acerifolii*	July 27	Maple	Bar Harbor.	
Oyster shell scale, *Mytilaspis pomorum*	April 29	Cornus	Winter Harbor	Killing big branches.
Scale, *Aspidiotus*	June 13	Bay laurel	Bar Harbor.	
Scale, *Lecanium*	June 20	Apple	Lincoln.	
Morgn's scale, *Chrysomphalus dictyospermi*	Aug. 14		Bar Harbor.	
Cottony maple scale, *Pseudococcus aceris*	July 8	Maple	Sanford Mills	Great numbers.
Garden flea hopper, *Halticus uhleri*	July 27	Clematis virginiani and Clematis vitalba	Bar Harbor.	

*See discussion under "Insects of the Year" in this bulletin.

INSECTS RECEIVED FOR IDENTIFICATION—CONCLUDED.

Name.	Date.	Host.	Locality.	Remarks.
Tarnished plant-bug, *Lygus pratensis*	May 2	Pear	Harrison	On buds of young pear tree. Numerous.
———, *Dog-day cicada*	July 17		Vanceboro	Pupa.
———, *Cercopids*	Aug. 12	Garden plants	Portland	On flower and leaves in garden. Caused buds to drop.
Giant water bug, *Belostoma americana*	Oct. 7		Pittsfield.	
Horntail, *Urocerus albicornis*	Aug. 30		Lewiston	Female.
Giant saw-fly, *Cimbex americana*	Aug. 8		Ellsworth	Larva.
Giant saw-fly, *Cimbex americana*	Aug. 11	Elm	Cornish	Cocoon.
Oak fig gall, *Biorhiza forticornis*	Aug. 21	White oak	Woodfords	Galls common.
Pear slug, *Eriocampoides limacina*	Sept. 15	Cherry Quince	Lewiston	Larvæ.
Mossy rose gall, *Rhodites rosæ*	Oct. 10	Rose	Castine	Galls with larvæ.
Maple spot gall, *Sciara ocellata*	June 29	Maple	Hancock Point	Numerous.
Comb-horned fish-fly, *Chauloides pectinicornis*	July 13		Gardiner	Adult.

FIG. 11. Strawberry crown girdler. Adult x 8.

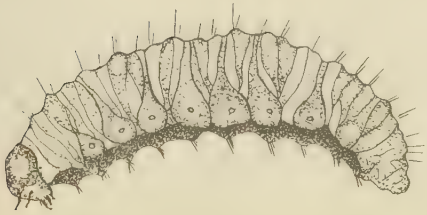


FIG. 12. Strawberry crown girdler. Larva x 8.

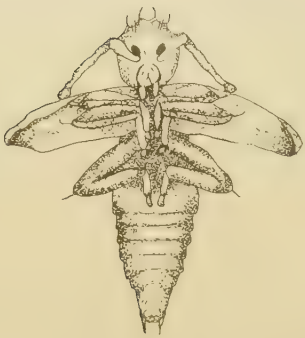


FIG. 13. Strawberry crown girdler. Pupa x 8.

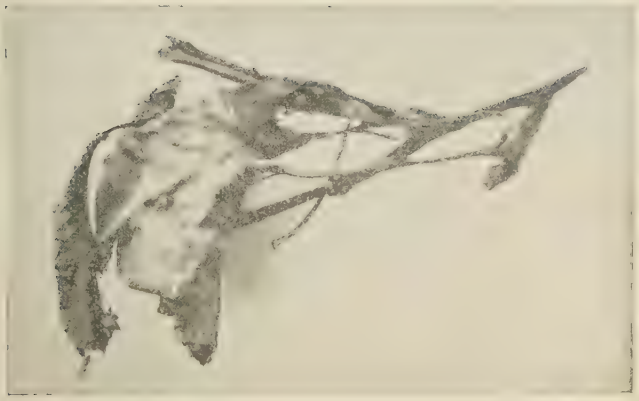


FIG. 14. Nest of brown-tail moth, containing no eggs but many small caterpillars.

FIG. 15. Cocoon, eggs and caterpillar of tussock moth.

FIG. 16. Red-humped caterpillar.

Fig. 17. Chain-dotted geometer.

Fig. 18. Hickory tiger moth.

Fig. 19. Moth of yellow-necked caterpillar.

Fig. 20. Mourning cloak butterfly.

Fig. 21. Work of rose-chafer in apples.

INSECT NOTES FOR 1906.

EDITH M. PATCH.

BROWN-TAIL MOTH AND GYPSY MOTH.

Since 1903 the brown-tail moth has become established throughout the Southern and most of the coast counties of Maine. In December, 1906, egg clusters of the gypsy moth were found in Kittery and Elliot. The caterpillars of the brown-tail moth are capable of ruining orchard, shade, and many woodland trees. They are also a dreaded nuisance because their hairs break off and on coming in contact with the human skin, cause extreme irritation and often illness. The caterpillars of the gypsy moth attack nearly every kind of vegetation and their work is especially fatal to pine and other evergreens since these trees always die after being once defoliated.

BROWN-TAIL MOTH.

So serious a pest should be known by every one in the State, because although extermination of this insect may not be possible, much practical and effectual work can be done in holding it in check and reducing its numbers to such an extent that damage to orchard and shade trees may be very slight.

For the past two years the State Department of Agriculture, the State Pomological Society, the Maine Agricultural Experiment Station, the town and city officials, and the citizens of the infested localities have worked in unison against the brown-tail moth. As a result this insect has not yet done very serious damage in this State, and the cases of poisoning have been very few. This is cause both for congratulation and encouragement for it shows that even if the brown-tail moth cannot be exterminated, its ravages may be in a large measure controlled. But the same distressing conditions threaten the State this coming year, and over a much larger district, and to be met successfully these conditions must be met as vigorously and as earnestly as they have been previously.

A simple warning to any one who may not be alive to the importance of fighting this insect is given in this bulletin by the significant photograph kindly supplied by Mr. A. H. Kirkland, State Superintendent for Suppressing the Gypsy and Brown-tail Moths in Massachusetts. The photograph, Fig. 16, shows apple trees stripped by caterpillars of the brown-tail moth, June 9, 1905, Winchester, Mass.

DESCRIPTION AND HABITS.

The moths. The moths, expanding from one and one-fourth to one and three-fourths inches, are white except for the abdomen, which is tinged with brown and tipped with a tuft of brown hairs. This tuft is small and dark in the male, but the large golden-brown tuft in the female is conspicuous enough to be the most striking characteristic of the moth, and has won for this insect its descriptive name of "brown-tail." These moths are on the wing in July, and unlike some closely related pests, the brown-tail females as well as the males are strong fliers. They are active at night, and as lights have an attraction for them, they sometimes fly a long way toward a lighted district.

The eggs. The female usually selects a leaf near the tip of the branch on which to deposit from 150 to 300 eggs. Some of the brown hairs from the abdominal tuft adhere to the egg-mass and give it the appearance of a brown felt lump.

The caterpillars in the fall. By the middle of August most of the eggs are hatched and the young caterpillars spin a slight web over the leaf near the egg cluster. From this protection they advance side by side, sometimes 200 tiny caterpillars feeding in an unbroken line, though they huddle together beneath the web when disturbed in any way. When they have eaten all but the skeleton of the first leaf, they draw another into the web and repeat the process at intervals during the late summer. They feed slowly, however, and spend so much time spinning their web that they do comparatively little damage to the trees in the fall, and they are still very small, (about one-fourth of an inch in length,) when cold weather comes on.

The Winter Nests. In the fall the young caterpillars weave additional layers of silk about their retreat, fastening it securely to the branch by the web, and pass the winter thus in colonies of 150 to 300. This is a very unusual yet most commendable habit in a caterpillar pest, for they can be killed, hundreds at a

time, simply by burning the nests in which the colonies hibernate. The nests, composed of leaves bound firmly together by silken web, are varied in shape, those upon oak trees for instance being differently formed from those upon wild cherry, in accordance with the difference in the size and pliability of the leaves. They vary too, more or less, upon the same tree, in the number of attachments to the twig and somewhat in size. However, this variety in size and shape serves as a distinctive mark, as it distinguishes nests of the brown tail moth from the uniform and regular shaped cocoons of other moths found often upon orchard trees in winter. In spite of the superficial variety, the essential characteristics of the brown-tail moth nests are soon learned, and even anyone unfamiliar with the nest can make himself perfectly certain if he will cut carefully into the nest. *If the structure contains one or more silken cells filled with tiny living caterpillars it is the winter nest of the brown-tail moth.* Two types of the winter nests are shown in Figs. 17 and 18.

The caterpillars in the spring. Early in the spring the young caterpillars emerge from their winter nests and feed upon the opening leaf buds. Until about the middle of June they feed greedily upon the leaves, completely stripping the trees where they are numerous. Orchard trees are especially susceptible, but oak, elm, and many other shade and forest trees are often ruinously attacked. When full grown the caterpillars are about one and one-half inches long. They are dark brown with a sprinkling of orange. Long, fine reddish-brown hairs cover the body, and a row of conspicuous white hairs runs along each side. Like the caterpillars of the tussock and gypsy moths, they bear bright red tubercles on the top of the sixth and seventh abdominal segments.

Poisonous qualities of the caterpillars. Were the caterpillars to be feared only for their ravages upon orchard and other trees, the situation would be alarming enough, but not less serious is the physical discomfort experienced by people living in infested districts. When the minutely barbed hairs of the caterpillar come in contact with the skin they cause an eruption similar to and in many cases worse than ivy poisoning. These hairs are brittle and where the caterpillars are numerous few people are likely to escape, as the caterpillars drop from the branches and creep about, even entering houses. Direct contact with the insects themselves is not necessary however, for when the cater-

pillars shed their skins the molts are blown about, widely scattering the barbed hairs. Thus in infested districts it is no uncommon occurrence for whole families to suffer from the rash caused by the hairs which settle upon clothes hung out to dry. Children gathering cherries are badly "poisoned," and people have been obliged to leave their homes for uninfested places in order to recover from attacks of the "caterpillar rash," which sometimes results in serious illness.

The cocoon. The caterpillars are usually full grown in June. They then spin loose cocoons, attached commonly to leaves, though sometimes other shelter is sought. Within these they transform to brown pupæ about three-fourths of an inch long. From the first to the twentieth of July the moths with pure white wings and brown-tipped abdomens emerge from these cocoons to deposit eggs for the next generation of caterpillars.

REMEDIAL MEASURES.

Natural Enemies. In the course of time, the natural enemies may become established also and take their share in the work. Doctor Howard, Chief of the Bureau of Entomology, and Mr. A. H. Kirkland, Massachusetts Superintendent for Suppressing the Gypsy and Brown-tail moths, are uniting their efforts in introducing parasites of these moths from European countries. Results from such work are necessarily slow and though the parasites may in time become a most effective means of lessening the numbers of these introduced pests, as parasites already do with many native moths, for the present season at least they cannot be expected to serve for a substitute for other remedial measures.

Cutting and burning the winter nests is the most important of the remedies because it is the easiest, cheapest, and, if thoroughly done, a sufficient protection against the ravages of this pest. The webs and leaves that compose the nest are woven tightly to the tips of the branches and hang there like dead leaves all winter. With so many months for inspection there is no excuse for harboring the hibernating caterpillars on shade or orchard trees. After they are cut from the branches, the nests should be burned, as this is the simplest way of destroying the colony within.

Destruction of breeding places. Much can be done in infested districts by clearing out wild cherry tangles and other growths which serve as a breeding place for these moths.

Spraying. The caterpillars are readily killed by arsenical sprays. The remedy is most effective when applied as soon as the leaves develop in the spring. Of course where the winter nests have been destroyed there will be no need of this remedy and it is much easier to kill about 200 caterpillars enclosed in a nest than to wait until they are scattered over the tree.

Legislation Against the Brown-tail and Gypsy Moths.

Legislation in Maine. In Maine the alarming invasion of the brown-tail moth during 1903 and 1904 emphasized the need of legislation against the ravages of dangerous insects and diseases, and in February, 1905, an act was passed to provide for the inspection of nurseries and incoming nursery stock, and placed with the Commissioner of Agriculture the duty of investigating any locality where the presence of dangerous insects or plant diseases may be suspected.

National Legislation. Appreciating the necessity of combating the brown tail and gypsy moths which threaten not alone the New England States, but the vegetation of the whole country, the last United States Congress passed an emergency appropriation of $82,500 to be used in preventing the further spread of these insects as far as possible.

Aroostook Potato Insects.

Wherever native vegetation is destroyed over a large area and a cultivated crop substituted, the equilibrium of insect conditions is upset, and a readjustment ensues If the plant-feeding insects of the locality are able to adapt themselves to a diet of the cultivated crop, the readjustment is of economic interest.

The potato fields of Northern Maine present an opportunity for observation along this line. Approximately 6,000 acres have been opened to the potato crop in Aroostook County during the past 16 years. What has become of the insects originally feeding upon other vegetation over these 6,000 acres is chiefly a matter of fruitless speculation. In general they have died, changed their location, or accepted the potato as an article of diet.

The inevitable Colorado potato beetle is taken philosophically here as elsewhere as a part of potato culture, and certain

fields kept clear of it by adequate spraying and, especially late in the season, certain fields given over to its ravages with apparent indifference.

Tomato Flea Beetle. Probably more serious injury to the potato vines is inflicted by the common tomato flea beetle, *Epitrix cucumeris,* than is generally credited to this insect by potato raisers, as it is found upon the leaves during the whole season, often in enormous numbers, and the punctured and riddled leaves cannot of course do full duty in such a condition.

Smartweed Flea Beetle. In addition to these two foregoing omnipresent pests, the Aroostook fields possess some more distinctive features. About the middle of September the smartweed flea beetles, *Systena hudsonias* were even more numerous than the smaller species. Both at Caribou and Houlton they were especially abundant and a potato leaf untouched by them could scarcely be found.

Cosmopepla carnifex. A pretty black and red bug, *Cosmopepla carnifex,* content before the advent of the potato to feed upon tender poplar shoots, and mint and buttercup stems, has shown no hesitation in accepting the new feeding grounds. By way of illustration it may be cited that on Sept. 12 at Caribou 11 of these bugs were found with their beaks deep in a single potato stalk. The bugs looked healthier than the stalk.

Pentatoma juniperina Linne. This large green bug, not uncommon in the State upon evening primrose, was found upon the potato, at Caribou July 11, where it was accused of wilting the stalk.

Tarnished Plant Bug. The tarnished plant-bug, *Lygus pratensis,* of evil reputation everywhere, is guilty of various annoyances in Maine. In some parts of the State, pear trees suffer through serious attack of the swelling leaf and flower buds in the spring. In a second the aster buds are "buttoned" by this bug so that "no perfect flowers can be obtained for sale." From a third, complaints accompanied by tarnished plant-bugs, state that all of many dahlia blossoms are deformed,—opening feebly only on one side. At Portland they were thick upon celery. The adults of this species can be startled from goldenrod blossoms almost anywhere in the State. It is not surprising to find such an adaptable insect taking without question the food offered it over thousands of acres of potato vines. About the middle of September different fields over a stretch of 7 miles

near Houlton were visited. All these fields were infested by the tarnished plant-bugs, and in one field visited early in the morning before the insects had warmed up enough to be much on the wing 40 or 50 plant-bugs to a single plant was not an unsual number. This fact seems an alarming one, for though the injury so late in the season may not be of great importance, the hibernating adults, if they attack the early tender shoots in the spring as is their habit on other plants, will cause much deformed and stunted growth another season. The tarnished plant-bug is not an easy foe to meet. Paris Green or other stomach poisons are useless against an insect with sucking mouth parts. Kerosene emulsion or other contact remedies are not practical for a pest which is so easily startled to flight. At the slightest disturbance the plant-bug is on the wing and in condition to return to the plants when the danger is over. From certain garden plants the plant-bug can readily be shaken onto a cloth or into a pan containing kerosene, early in the morning or on cold days when they are too sluggish to be easily alarmed. Such a means would, of course, be impractical in a potato field. There remains apparently but one vulnerable point, based upon the fact that the tarnished plant-bug hibernates in the adult condition among weeds or other rubbish. The custom of potato raisers of raking up and burning the old vines in the fall in order to have fields clear for fall plowing is therefore one of the most effectual ways of destroying the shelter of these bugs. If, in addition to clearing away the old vines, the weeds and rubbish along the edges of the potato fields should be burned on a cold day, great numbers of the tarnished plant-bugs would be destroyed with comparatively little cost and time. If the plant-bug continues to appear upon the potato vines, this means of combating it should be resorted to regularly each fall.

Nectarophora solanifolii. In a land flowing with honey dew as has been the whole State of Maine for several years past, even the potato cannot hope to escape aphid attacks. A large green species, *Nectarophora solanifolii* Ashm. has for 3 seasons attacked the potato vines in the vicinity of Houlton and elsewhere to an injurious extent. The colonies cluster thick on stem and leaf, thousands to a plant, frequently wilting the stems and drying the leaves. The worst of the attack comes between the middle of August and the middle of September in time to weaken the plant and thus effect the growth of the tubers. The

true sexes of this species do not appear upon the potato. It is not yet known what plant serves for the alternate host.

Aphis sp. This present season in some parts of Aroostook, conspicuously at Caribou and vicinity, a second species of plant louse, an undetermined and probably a new species belonging to the genus *Aphis*, has heavily infested certain fields. They were beginning to appear upon the vines about the middle of July and they had not all taken flight by the middle of September. At the later date colonies of pupæ could be found here and there at Caribou, clustered thick enough on stalk tip and new growth to hide the stalk. The bodies of these pupæ shaded from pink to salmon and from green to brown. They seem invariably to feed head down.

The presence of plant lice to such an extent upon potato vines raises several perplexing problems. If a fairly uniform attack could be reckoned on each year, the cost, benefit and practibility of emulsion sprays on the infested fields would be well worth testing. Plant louse attacks, however, are likely to be irratic, influenced by climatic conditions and by decrease and increase of parasites and predaceous insects. As yet it seems to be an open question as to whether it is most practical to attempt to combat the aphids in the potato field by artificial means, or leave them to fluctuate according to natural influences. At any rate their presence is to be regretted. Even a light attack which would not preceptibly weaken the plant, probably renders it more susceptible to fungus diseases than it would normally be. For the past 3 years the aphid attacks on potato have been widespread. Dr. James Fletcher, Central Experimental Farms, Canada, writes from Ottawa, September, 1906, "The aphis has been extremely abundant on our potatoes all through this part of Canada this year." It also troubled Canadian fields in 1904.

Alder Blight and Attendant Insects.

A conspicuous illustration of the natural fluctuations of insect conditions is given by *Pemphigus tesselata* in the vicinity of Orono. This species, a large dark bodied plant louse infesting the trunks and branches of alder (*Alnus incana*), is often mistaken for fungus on account of the snow-white flocculent matter with which it is covered. For several seasons the alder clumps here as in many other parts of the State have been white stemmed with this woolly plant louse, and early in September the air has been alive with the winged forms.

Syrphus maggots. The chief enemy which had for two seasons confronted the "alder blight" was a syrphus fly, which could be seen hovering near the colonies for the purpose of depositing eggs. The maggots hatched from these eggs fed greedily upon the large soft bodied plant lice, but the enormous numbers of the plant lice did not seem to be materially lessened. The winged forms were plentiful last fall, 1905. This spring the colonies were common but not so numerous as for several seasons past. The syrphus maggots work industriously and often white "wool" upon the alder stems was found to cover more maggots than plant lice. It seems likely that the syrphus flies could clear the vicinity of "alder blight." Late in the summer, however, it was discovered that the syrphus flies no longer had the "alder blight" to themselves. A rival appeared in the form of the Harvester butterfly.

The Harvester, Feniseca tarquinius. (Fig. 19). During September caterpillars of the Harvester could be taken in almost any colony of "alder blight" in the neighborhood. Like the syrphus maggots, these caterpillars burrow beneath the woolly secretions of the plant lice and are covered from sight. The full grown caterpillar is slightly more than one-half inch in length and slug like in shape. The body is drab colored and the head a shiny brown. The 12 segments of the body are deeply creased and scalloped along the lateral margin. There is a mid-dorsal line of black dots with an orange spot at each side. Each orange spot is lined laterally with black. The body is well covered with black bristly spines to which flocculent masses from the alder blight becomes attached. The curious chrysalis (Fig. 20) of this insect is a half uncanny, wholly fascinating little object with the dorsal aspect possessing a remarkable resemblance to a monkey's face. The adult butterfly (Fig. 21) expands about one and one-fourth inches. The colors of the upper surface of the wings are black and tawny. The black spots are subject to much variation in form and size.

So industriously did the Syrphus maggots and the Harvester caterpillars feed upon "alder blight" that by the end of September hardly a colony of this plant louse could be found in the vicinity of Orono.

Alder blight covered by ants. In connection with a series of observations which were being made this season on alder blight, an interesting bit of ant work was noticed August 30. A colony

of ants had its quarters in some small decaying tree trunks fallen at the base of a clump of alder. Two of the alder stems were thickly infested with *Pemphigus tesselata* much visited by ants for the honey dew. In this case the ants had built a covered tunnel from the base of the alder stems to the distance of nearly 2 feet on one stem and more than one foot on another. This structure was composed of sawdust-like particles and enclosed small clusters of the aphids which seemed undisturbed by the proceedings. The stems were upright and one ant tunnel was erected vertically along the stem while the second was more or less winding. The ants varied their occupation of extending the tunnel with sipping upon the convenient honey dew. Specimens of these ants were identified by Mr. Theo. Pergande of the U. S. Department of Agriculture as *Lasius mixtus* Mayr.

Larch Case-Bearer, *Coleophora laricella* Hbn.

Throughout Washington, Hancock, and Penobscot counties at least, and probably over a larger area a very minute moth has been to work on the larch, (*Larix americana*), or hackmatack, or tamarack as it is variously called.* The insect winters in the larval stage upon the larch and attacks the tender needles when they first start in the spring. Although minute they have been present in such enormous numbers that larch trees have often been, during the past 3 seasons, eaten bare of green early in the spring. The caterpillars feed by eating a hole in the side of the needle and then devouring as much of the inner portion as it can reach. It thus has the characteristic manner of feeding common to related leaf miners. The injured needles often continue to grow but the clusters are ragged and many of the needles brown and dry. Small larches in the vicinity of Bangor and Orono which have been subjected to an attack of at least 3 seasons died this summer from no other apparent cause than the presence of great numbers of the case-bearers which kept the needles eaten off. Many large larches infested by this insect look yellowish and unhealthy.

The larva. The caterpillar is a case-bearer, that is, it protects its body with an external covering or case. The larch case-

* Although so well supplied with popular names of its own, this tree is also erroneously but very commonly called the juniper in Maine.

bearer uses a bit of dried spill from the larch for its case and from this protection it extends its head and thoracix feet when it wishes to move about or feed. Along the ventral side the spill is split and pieced together with silk woven by the tiny caterpillar. As it grows it weaves an extension of this silk on the anterior part of the case. The full grown caterpillar is about 3 millimeters * in length. The case measures 4 millimeters or 5 millimeters. The caterpillars are much more active during warm and sunny weather, and during cold days they do no feeding. When fall comes on the nearly grown caterpillars in their little spill cases attach themselves to the bark and about the bud angles and live dormant for the winter. With the first warm days of spring the caterpillars become active and feed upon the soft tender larch needles. As the caterpillars are nearly full grown this is their most vigorous feeding spell and as the larch needles are eaten when they first begin to grow, it is a particularly hard season of the year for the tree to endure such an attack. The same number of case-bearers later in the season would by no means create so much damage.

The full grown caterpillars do not leave their cases but attach them to the twig or commonly in the cluster of needle shaped leaves where they are not easy to find and let the cases serve for a cocoon.

The moth. In the vicinity of Orono the adult insect emerges about June 4. They are a glistening ash gray in color. The wings are slender and the hind wings have the deep delicate fringe common to this group of moths. It expands about 9 millimeters. This moth is something the shape of the common clothes moth and a little smaller. The female deposits the eggs in among the larch needles and the young naked caterpillar eats its way into a needle and after disposing of the soft interior as food, uses the empty shell for its case.

There is fortunately but one generation a year. Observations upon these case-bearers about Orono had been made during 2 seasons when Dr. James Fletcher, Central Experimental Farm, Ottawa, published his interesting account of the appearance of the Larch case-bearer, *Coleophora laricella* in Canada (Report 1905). Doctor Fletcher kindly compared specimens bred in Maine with the Canadian *Coleophora* and pronounced them undoubtedly the same species. Ratzeburg in his Forst-Insecten

* One inch nearly equals 25 millimeters.

gives excellent figures in color of the larva, moth, and work of *Tinea laricinella* which if it is not the same species as *Coleophora laricella* so closely resembles it that the same figure would serve for both.

There would not seem to be any practical remedy against this insect in large growths. Since it eats the inner portion of the needles and leaves the epidermis, arsenical sprays would hardly avail on the larches used for ornament. In nurseries, badly infested trees should be burned. From very small trees the majority of the cases could be removed by hand during the winter. Japanese Larches * are said to be immune from attack by this case-bearer.

Miscellaneous Notes.

Of the many insects which naturally come under observation during the season, a few are conspicuous for various reasons, as the attendance of particular parasites, the occurrence in great numbers of an insect not usually abundant, or the appearance of an insect on some plant it does not commonly attack. Such instances are often of more than passing interest and are conveniently recorded under miscellaneous notes of the year.

Yellowhead Cranberry Worm on Sweet Gale. The yellowhead cranberry worm, *Teras minuta*, was present this season over cranberry beds near Charlotte. The culture of these beds had been somewhat neglected and sweet gale, *Myrica gale* had crowded into the beds from all directions. The tips of the sweet gale were everywhere conspicuously spun together and examination showed the culprit to be the yellowhead cranberry worm which was working also in the cranberry vines. The pest was attacking the sweet gale to a much greater extent than it was the cranberry itself. This fact was so marked that it suggested, as apparently practical, a simple remedial treatment for this locality. It was recommended that all of the sweet gale, which was injuring the cranberries by its presence as a weed, should be torn out except strips of it near the edges of the beds which were to be left as a trap. The sweet gale, left as attractive bait for the yellowheads, could be treated to a heavy spray of arsenate of lead early in the spring, in time for the first brood of larvæ, thus killing in small space the majority of the pests. The beds, it should be stated, are in a dry bog and resort

* Insect Life. Vol. IV. Page 405.

to flowing would mean considerable expense. The same insect was present at Charlotte upon apple trees but not to a great extent.

The Apple Maggot and the Codling Moth. Both these insects are at work in this State to a regrettable and injurious extent. There is considerable confusion among orchard owners as to the character and names of these two pests. The term "apple maggot" is unfortunately applied indiscriminately to the larva of "Trypeta" and the codling moth, and the term "railroad worm" is not much more definite, especially if the trails extend away from the surface of the apple. The present season one man reported that nearly all his apples were "ruined by the 'railroad worm' or 'wire worm' as it is sometimes called." In view of such confusion the following brief statement may not be amiss.

"Apple maggot," "railroad worm," and "Trypeta" should all properly apply to the larva of a striped winged fly, *Rhagoletis* (*Trypeta*) *pomonella*. This larva is a *maggot*, a small but plump, white, footless object with head so ill defined that it is difficult to find at all, and the mouth parts reduced to a pair of hooks. The apple maggot works in soft discolored mushy trails anywhere in the pulp of the apple. When these trails lie immediately under the skin of pale skinned apples they show through like tiny but clearly defined tracks, and the descriptive term "railroad worm" has been given the maggot which travels along these tracks. The trails of the apple maggot never contain little round sawdust like pellets, and they do not extend into the core of the apple.

The codling moth (*Carpocapsa pomonella*) is a true moth. The fore wings are irregularly streaked with gray and brown, and have a horseshoe marking of copper color at the inner angle. The hind wings are of light yellowish brown. The moth expands about three-fourths of an inch. The larva of this moth is a tiny naked *caterpillar* with clearly defined head region and three pairs of legs upon the segments immediately behind the head. It has the ordinary biting mouth parts of other caterpillars and resembles the closely related leaf folding caterpillars (Tortricids) in its motions, wiggling violently backward when disturbed. The larva of the codling moth makes excavations in the apple, extending them usually into the core itself. These excavations always contain little, round, brown, sawdust-like, pellets which are the excretions of the larva.

The apple maggot and the larva of the codling moth are often present in the same apple. Discussions of the life history, habits and remedies of these two pests are given in other available bulletins of this Station and are therefore not repeated here.

Lace Bugs. The recently described * Tingitid, *Corythuca pergandei* Heid. was extremely numerous upon willow and alder (*Alnus incana*) between Bangor and Orono this season.

Infested Spruce Cones. Late in August the cones on the Norway spruces on the campus were observed to be dropping prematurely. Examination showed a general infestation by a Lepidopterous larva about seven-eighth of an inch in length. Some were a uniform purplish brown, others showed a greenish color on the thoracic segments with 2 tiny black spots on the first segment behind the head. These larvæ began spinning cocoons about the middle of September. The cocoons are the color and transparency of thin white tissue paper. The average length is about one-half inch and they are usually about one-fourth of an inch wide, though sometimes the cocoons are nearly as broad as long. Pupation does not take place at once but the caterpillar, readily seen through the thin cocoon, lies for days in a U shaped loop. If the cocoon is disturbed, the caterpillars break through and travel off actively and with apparent irritation. The infested cones were prematurely brown in the vicinity of the larval tunnels. The excavations were chiefly at or near the center of the cones, from one to several larvæ being present in a single cone. Through the kindness of Doctor Howard specimens were referred to Mr. Fiske (Bureau of Entomology, Washington, D. C.) who stated them to be evidently a species of Pinipestis, mature moths being necessary for full determination.

Maggots which were attacking the decaying portion of the cones infested by these caterpillars developed in abundant numbers into *Drosophila amœna* Loew, kindly determined by Mr. D. W. Coquillett. This small red-eyed fly with yellow thorax and dark abdomen, and wings crossed with 2 dusky bands, is not uncommon about decaying fruit.

Harvest fly, *Tibicen rimosa.* A very pretty harvest fly, or cicada, belonging to the same genus as the periodical cicada was common in the vicinity of Orono from the middle to the latter part of July. (A photoghaph of this species is given as Fig.

* Proceedings of the Entomological Society of Washington, Vol. VIII. Nos. 1-2.

22.) The head and thorax have clearly defined marks of deep orange yellow, along the posterior margin of each abdominal segment is a narrow but distinct line of the same color, and the wings near the body are clouded also with orange. The expanse of wings averaged about 2 and one-half inches. The species was kindly determined by Mr. Heidemann as *Tibicen rimosa* Say, var: *noveboracensis* Fitch.

Diamond-back Moth, Plutella cruciferarum, as a Greenhouse Pest. Early in April a complaint came from a greenhouse in Ellsworth of a small green caterpillar which destroyed ten weeks stocks, working on leaves and flowers. Specimens were received with the communication and were bred to the adult stage, part of them proving to be the light form and part the dark form of the Diamond-back. On May 24, a new lot of these larvæ were received from the same source again at work upon the stocks. This species, described with reference to materials bred on stocks in greenhouse, is as follows:

The caterpillars when full grown are three-eighths of an inch in length. The color is a light green with the head concolorous or sometimes shading to yellowish. The median dorsal line is a more vivid green. To the naked eye they appear smooth, but a low power glass reveals stiff dark hairs rising from lighter spots arranged in a regular manner upon the segments. These hairs are most numerous upon the last thoracic segment. The last pair of abdominal pro-legs are extended back horizontally giving the body a forked appearance. The pupal stage is passed within a very delicate white, gauzy cocoon through which the pupa is readily seen. Some of the specimens reared passed but 6 days in the pupal stage.

The perfect insect is a moth expanding about five-eighths of an inch. The fore wing is ash colored with minute dark spots upon it. A yellowish stripe outlined with a dark line extends along the hinder margin in such a manner that when the wings are closed, 3 light colored diamond shaped markings are formed. Both pairs of wings are a uniform gray on the under side. The antennæ are marked with alternate rings of white and dark.

The Diamond-back is an imported moth and it occurs frequently upon cabbage and cauliflower in the garden. Doctor Fletcher reports * the Diamond-back to be an incessant and most troublesome pest upon garden stocks and wall-flowers

* Can. Exp. Farms 1890, p. 165.

from about July till the frosts in November. The remedy most frequently recommended is kerosene emulsion.

The greenhouse infestation at Ellsworth started on stocks that had been transplanted from outside and the larvæ were probably taken in with them, successive generations developing within doors. Hand picking proved to be a perfectly effectual remedy though a tedious task.

Six Troublesome Orchard Insects. The yellow-necked caterpillar, *Datana ministra,* and the red-humped caterpillar, *Œdemasia concinna,* have created much alarm in Maine this year. Entire orchards have been despoiled by these pests. Young trees have suffered the worst injury not because the caterpillars show a preference for them, but because one brood is sufficient to strip a small tree, and the same number of leaves from a large tree does not mean so serious a loss. *The bud moth, Tmetocera ocellana,* is at present doing much damage in Maine orchards. Two species of tussock moths, *Notolophus leucostigma* and *antiqua* have been abundant in most parts of the State as has the orchard tent caterpillar.

Limneria guignardi Prov. The red-humped caterpillars have been in the southern counties abundantly attended by an ichneumon parasite, *Limneria guignardi* Prov.* These parasites attack the young caterpillars in the early stages, at which time the caterpillar is just the right size to serve for food for a single parasite. The parasite grub when full grown forms its cocoon within the empty skin of the caterpillar which fits tight over the cocoon. The caterpillar head being still attached, the object is a curious one. When about to emerge the adult parasite gnaws a hole at one end of the cocoon and takes wing. This hole is sometimes near the head and sometimes near the caudal end of the caterpillar skin. See Fig. 23.

Yellow-edge Butterfly. From York to Aroostook counties the spiny caterpillars of the yellow-edge butterfly, *Euvanessa antiopa,* have been common on elm and willow. This species has been almost constantly mistaken for gypsy caterpillars, and has been the cause of numerous false alarms. A brood is occasionally found upon apple trees, but it does not seem likely to become an orchard pest, its preference is so evidently for willow

* Determined by comparison with Canadian material through the kindness of Doctor Fletcher.

and elm. A Tachina parasite is active against these caterpillars in Maine.

Garden Fleas. In contrast with the past two seasons no observations of the garden flea, *Smynthurus albamaculata*, Harvey were made. During the early spring, at the time these minute insects have previously been most conspicuous, continuous rains prevented field observations on such insects as these. The account of injury due to this species given in Bulletin No. 123 of this Station, page 220, was the occasion of several requests from specialists in this group for reference to the original description. Professor Harvey's description together with drawings by Mr. J. H. Emerton were published in the Report of this Station for 1896, pages 124-126.

Mosquitoes. There is no adequate record of Maine mosquitoes although in many parts of the State certain species are excessively troublesome. A few collections were made this season and sent to the Bureau of Entomology, Washington, D. C., where several specialists are at work on this family. Doctor Dyar kindly determined them as follows:

Anopheles punctipennis Say. Orono, July 27 and October 1, about light in house.

Anopheles quadrimaculatus Say. Orono, September 20, in house.

Aëdes fuscus O. S. Orono, July 27.

Aëdes canadensis Theob. Trenton, August 10; Caribou, August 17.

Aëdes sylvestris Theob. Trenton, August 10.

Aëdes sollicitans Walk. Trenton, August 10.

Aëdes abfitchii Felt, *fitchii* Felt, or *subcantans* Felt. (Adults alike—need larvæ to separate). Orono, August 3; Trenton.

All of the species of *Aëdes* except *fuscus* given in the foregoing list were until recently commonly referred to the genus *Culex*.

Insects for Identification. A few, only, of the large number of insects received for identification this season are recorded in the following pages.

Such common, widespread, and constantly occurring forms as the cecropia moth and oyster-shell scale have been omitted. Such information as the increasing parasitism of the red-humped caterpillar has been summarized in a single statement elsewhere in the bulletin rather than listed as 70 or 80 separate items.

INSECTS RECEIVED FOR IDENTIFICATION.

Name.	Date.	Host.	Locality.	Remarks.
Nessus sphinx, *Amphion nessus*	June 14	..	Orono.	Adult.
Galium sphinx, *Deilaphila chamænerii*	June 14		Orono	Adult.
Wild cherry sphinx, *Sphinx drupiferarum*	June 16	.....	Orono	Adult common.
Thysbe Clear wing, *Hemaris thysbe*	June 18	.....	Surry	Moth on lilac blossom.
Azalea sphinx, *Ampelophaga choerilus*	June 29		Bar Harbor	Male
Small eyed sphinx, *Paonias myops*	July 14		Orono	Adult.
Big poplar sphinx, *Marumba modesta*	July 13		Orono	Adult.
Pen marked sphinx, *Sphinx chersis*	July 14		Bangor	Female.
Apple sphinx, *Sphinx gordius*	July 17		New Vineyard	Female.
Laurel sphinx, *Sphinx kalmiæ*	July 27		Orono	Adult.
Morning sphinx, *Dedephila lineata*	Aug. 1		Eden	Larvæ full grown.
Twin spotted sphinx, *Smerinthus geminatus*	Aug. 1		Waterford	Adult.
Woodbine sphinx, *Photus achemon*	Aug. 14	Woodbine	North Berwick	Larvæ "appear every year".
Four horned sphinx, *Ceratomia quadricornis*	Sept. 1		Houlton	Larva.
Walnut Datana, *Datana angusii*	Aug. 22	Walnut	North Berwick.	Larvæ numerous, specimen parasited.
Walnut Datana, *Datana angusii*	Aug. 27	Walnut	North Berwick	Trees entirely stripped of leaves.
Unicorn prominent, *Schizura unicornis*	Aug. 22	Apple	Green	
Unicorn prominent, *Schizura unicornis*	Aug. 28	Apple	Jonesboro	
Unicorn prominent, *Schizura unicornis*	Sept. 1	Apple	Deer Isle	
Unicorn prominent, *Schizura unicornis*	Aug. 14	Apple	North Jay	
Hag moth, *Phobetron pithecium*	Aug. 2		North Buckfield	Cocoon.
Yellowhead cranberry worm, *Teras minuta*	Aug. 29	Cranberry	Charlotte	Larvæ numerous
Lesser apple leaf folder, *Teras minuta*	June 21	Apple	Foxcroft	Larvæ numerous in orchard.
Fork-tailed caterpillar, *Cerura borealis*	Sept. 7		Weeks Mills	Larva.
Apple Bucculatrix, *Bucculatrix pomifoliella*	Sept. 10	Apple	East Corinth	Ribbed cocoons numerous.
Apple Bucculatrix, *Bucculatrix pomifoliella*	Oct. 15	Apple	Manchester	Ribbed cocoons.
Hickory tiger moth, *Halisidota caryæ*	Sept. 17	Apple	Drew	
Lappet moth, *Tolype velleda*	July 31		East Orrington	Larva full grown.
Beautiful wood nymph, *Eudryas grata*	Aug. 6		Hampden Corner	Adult.
Pearly wood nymph, *Eudryas unio*	July 23		Orono	Adult.
Tussock moth, *Notolophus leucostigma*	Aug. 7	Raspberry	Norridgewock	Much damage.
Fingered dagger moth, *Acronycta dactylina*	Aug. 18		Ellsworth	
——— *Acronycta americana*	Sept. 7	Maple	Bar Harbor	Larva.
Crompton tortoise, *Vanessa j-album*	Sept. 23		Charlotte	Adults very common.
The Relict, *Catocala relicta*	Sept. 9		Orono	Adults on birch bark.
Scalloped Owlet, *Scoliopteryx libatrix*	Feb. 16		Gardiner	Dead moth.

Diamond back moth, *Plutella cruciferarum*	April		
Budmoth, *Tmetocera ocellana*	June		
Spruce tortrix, *Tortrix fumiferana*	June		
Larch case bearer, *Coleophora laricella*	June		
Cherry tree leaf folder, *Caccecia cerasivorana*	July		
Cherry tree leaf folder, *Caccecia cerasivorana*	July		
Oak ugly nest, *Caccecia fervalana*	Aug.		
Stalk borer, *Papaipema nitela*	July		
Primrose moth, *Rhodophora florida*	July		
Twice stabbed Lady beetle, *Chilocorus bivulnerus.*	Aug.		
15 spotted Lady beetle, *Anatis 15-punctata*	June		
Saw-tooth grain beetle, *Silvanus surinamensis*	March		
White grubs, *Lachnosterna*	June		
Asparagus beetle, *Crioceris asparagi*	Sept.		
Beautiful maple borer, *Plagionotus speciosus*	July		
——— *Malachaus æneus*	June		
Tortoise beetle, *Coptocycla signifera*	July		
Tortoise beetle, *Coptocycla purpurata*	Sept.		
Spindle gall, *Pomphigus ulmi-fusus*	July		
——— *Pemphigus populitmondis*	Aug.		
Pineapple gall, *Chermes abietis*	Aug.		
——— *Chionaspis salicis*	Sept.		
——— *Eulecanium quercitronis*	June		
Pear tree Psylla, *Psylla pyricola*	Sept.		
——— *Pentatoma juniperina*	July		
Four-lined leaf-bug, *Poecilocapsus lineatus*	July		
Tarnished plant-bug, *Lygus pratensis*	Oct		
Tarnished plant-bug, *Lygus pratensis*	Sept.		
Tarnished plant-bug, *Lygus pratensis*	Sept.		
Tree hoppers, *Enchenopa binotata*	July		
Tree hoppers, *Telamona monticola*	Aug.		
——— *Diedrocephala versuta*	Sept.		
——— *Cosmopepla carnifex*	Aug.		
——— *Cosmopepla carnifex*	Sept.		
——— *Cosmopepla carnifex*	Sept.		
——— *Banasa dimidiata*	Sept.		
——— *Banasa dimidiata*	Sept.		
2	Stocks	Ellsworth	Larvæ destructive in greenhouse.
13	Apple	Turner	Larvæ.
20	White spruce	Bar Harbor	Larvæ.
26	Larix americana	Machias	Larvæ seriously stripping trees.
2	Wild cherry	Waterford	
13	Wild cherry	Skowhegan	Nest and pupæ.
1	Oak	Bar Harbor	Nest, larvæ and pupæ.
14	Sweet corn	Cape Elizabeth	Destroying much.
27		Orono	Moths common in closed flowers of œnothera biennis.
29	Plant-lice	Ellsworth	Numerous.
7	Plant-lice	New Vineyard	On house plants.
15	Flour	Farmington	
5	Grass roots	Harrison	Grubs worked two acres grass land so that it plowed like old ground.
17	Asparagus	Brunswick	¼ acre completely stripped by middle of August.
18	Maple	Unity	
20		Orono	Identified by Dr. Chittenden.
24	Convolulus sepium	Orono	Numerous.
13	Convoullus sepium	Orono	Numerous.
13	Elm	North Berwick	Numerous.
14	Poplar	Bar Harbor	Galls.
1	Spruce	Portland	Galls numerous.
15	Viburnum alnifolium	Houlton	Thickly infested.
23	White oak	Freedom	In great numbers.
1	Pear	Pittsfield	Work on pear leaves.
11	Potato	Caribou	Feeding on the stalk, wilting it.
24	Geranium	North Berwick	Troublesome every year.
1	Celery	Portland	Numerous.
15	Potato	Houlton	Enormous numbers.
25	Dahlia	Charlotte	Deformed and buttoned blossoms.
24	Wax work	N. Berwick	Great numbers.
1	Woodbine	Bangor	
10	Birch sprouts	Orono	Great numbers.
4	Mint	Orono	Great numbers.
12	Potato	Caribou	Common.
15	Poplar	Houlton	Abundant.
15	Willow	Houlton	Adults exceedingly numerous.
15	Mountain Ash	Houlton	Larvæ adults numerous in berry clusters.

INSECTS RECEIVED FOR IDENTIFICATION—CONCLUDED.

Name.	Date.	Host.	Locality.	Remarks.
Ichneumon, *Thalessa lunata*	Aug. 22		E. Wilton	Female.
Pear tree slugs, *Eriocampa cerasi*	Sept. 24	Cherry & Plum	Corinna	Bad attack.
Rose slugs, *Monostegia rosæ*	July 18	Rose	Hancock Pt.	Ruined appearance of bushes for four years.
Blackberry seed gall, *Diastrophus cuscutæformis*	May 4	Cultivated blackberry	Gardiner	
Giant American saw fly, *Cimbex americana*	Aug. 1	Elm	S. Berwick	Larva full grown.
Solitary wasp, *Eumenes fraternus*	Aug. 14		Gardiner	"Jug nest" and wasp which emerged.
——— *Limneria guigrardi*	Aug. 29		Augusta	Parasites bred from Œdemasia concinna.
King grasshopper, *Hippiscus tuberculatus*	June 2		Hampden Cor.	Male and female adult.
Sheep bot-fly, *Œstrus ovis*	May 3	Sheep	E. Dixfield	Maggots in nasal passages apparently caused death of sheep.
Maple spot-gall, *Sciara ocellata*	July 2	Maple	Seal Harbor	
Psocids	Aug. 14	Maple and mulberry	N. Parsonfield	On bark in "large droves".
Psocids	Aug. 14	Maple	Alfred	On bark "by thousands".
Psocids	Aug. 18	Maple	Lovell	On bark in great numbers.

Fig 16. Apple trees stripped by brown-tail moth, Winchester, Mass., June 9, 1905.
Photograph loaned by A. H. Kirkland

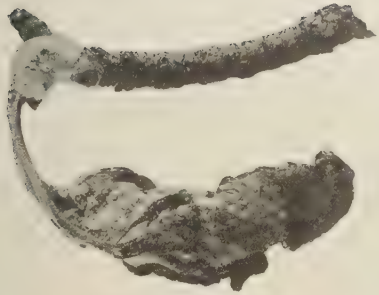


Fig. 17. Winter nest of brown-tail moth with one attachment to twig.

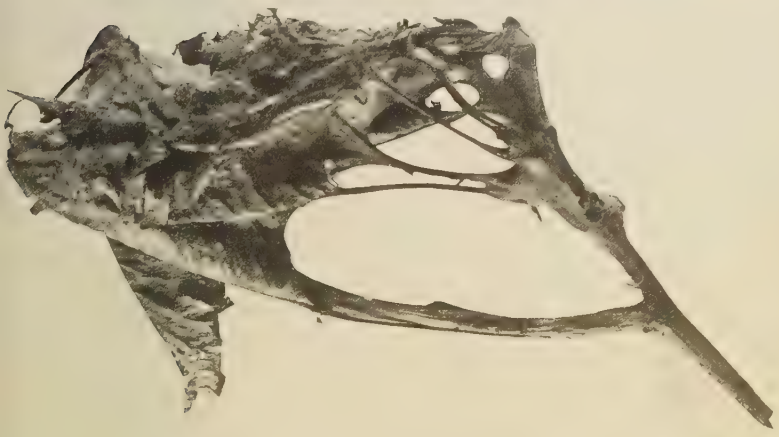


Fig. 18. Winter nest of brown-tail moth with several attachments to twig.

L. U
E.

Fig. 19. The Harvester.
Larva x 2.

Fig. 20. The Harvester.
Chrysalis x 2.

Fig. 21. The Harvester, Feniseca tarquinius.
Adult x 2.

Fig. 22. Harvest fly or Cicada, *Tibicen rimosa* Say, *noveboracensis* Fitch. Very slightly enlarged. Photograph of specimen taken at Orono, July 31, 1906.

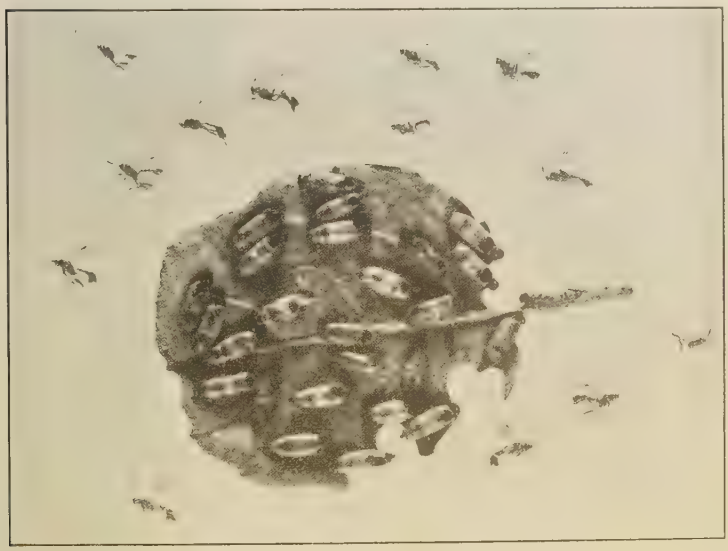


Fig 23. Parasited specimens of young red humped caterpillars attached to apple leaf, and parasites, (*Limneria guignardi*, Prov.), which emerged from them. Photographed from specimens taken at West Minot, August 29, 1906.

Circulars concerning the following insects are available for distribution and will be sent to any address in the State upon request.

Cecropia moth.
Tussock moth.
Brown-tail moth.
Red-humped caterpillar.
Yellow-necked caterpillar.
Tent caterpillar.
Yellow-edge butterfly.
Elm leaf curl.
White grubs and June beetles.
Cottony grass scale.
Gypsy moth.

BULLETIN No. 147.

THE POTATO PLANT LOUSE.

Nectarophora solanifolii Ashmead.

EDITH M. PATCH.

On account of their extremely small size, aphids or plant lice are to a great extent unnoticed, but when conditions are favorable to their increase there are many species of these minute creatures that are capable of bringing devastation to the vegetation which they frequent and staple crops often suffer severe attacks. The hop plant louse, the several aphids of the apple, the spring grain aphis, the corn aphids, the melon aphis, are, for instance, pests of tremendous importance; and the destructive green pea louse alone is estimated to have caused a loss of $7,000,000 during the two seasons of 1899 and 1900 just along the Atlantic Coast States. During the past 4 years many species of aphids representing 14 genera and living upon about 90 species of plants and trees have been collected for the Maine Agricultural Experiment Station and some few of these have been given special study. Of these the potato plant louse, attacking as it does one of our chief crops in Maine, and presenting in its life history certain points which may be of significance in connection with closely related species, has seemed of sufficient importance to record somewhat fully.

ECONOMIC SIGNIFICANCE.

During the summers of 1904, 1905 and 1906, enormous numbers of the plant louse, *N. solanifolii*, appeared over wide areas in Aroostook County, the potato vines being attacked to an injurious extent in the vicinity of Houlton and elsewhere. The colonies cluster thick on stem, leaf and blossom stalk, blighting

the stems and drying the terminal leaves. See Fig. 25. The time of severest attack apparently varies somewhat, but the infestation for the past 3 years in Maine has not been excessive before early August and is entirely over with before the middle of September. Under conditions favorable to Aphid growth, an attack of less than 2 weeks' duration suffices to kill the potato stalk for a distance from 4 to 6 inches from the tip, and the growth of the tubers on plants thus weakened must necessarily be affected. Aside from the direct weakening of the plant due to the loss of sap and the withering of the tissue, the danger to the health of a plant thus attacked by plant lice is considerable. Although exceedingly minute, the beak of the plant louse makes a wound which becomes in a short time surrounded by a discolored area, readily detected by the unaided eye. As these wounds extend for some little distance into the plant, a favorable location for the entrance of bacterial or fungus disease is thus secured even where the infestation of plant lice is not excessive enough to wither the tips of the stalk. Moreover it is perfectly possible for insects to carry fungus spores from diseased to healthy plants. Where the plant lice are abundant the leaves are covered with honey dew which is soon attacked by a dark fungus, and which together with the molted skins adhering to the sticky substance, gives the leaves an unhealthy appearance and must interfere with their natural function.

The same species has at times been extremely abundant upon the potato in Canada and the following quotation from Doctor Fletcher's report for 1904 is of interest in this connection both because of the seriousness of the infestation and the fact that the time of appearance at Mahone Bay where the observations were made was earlier than it has been in Maine.

"Potato Aphis (*Nectarophora solanifolii,* Ashm.).—Potatoes are not often troubled with plant lice in Canada; but at long intervals outbreaks have been observed on this crop, and such a one occurred last summer at Mahone Bay, which was closely watched by Doctor Hamilton.

'Mahone Bay, June 28.—I send you some aphides from potatoes which are abundant enough to have appreciably blighted my potato plants.'

'July 10.—The aphis on my potatoes has overrun the whole patch, with the result that the potatoes have stopped growing and look very unhealthy. The blossoms have withered up and fallen, the lower leaves have turned yellow, and many others have turned black, just as if smitten with the blight, and are falling. They occur in immense numbers. Their

favorite position is upon the peduncles of the flowers, which they cover completely. They are also found in large clusters on the stems and upon the under surface of the leaves. In many colonies there are a few flesh-colored individuals.'

'July 16.—The plant lice on the potatoes are fast diminishing in numbers; but they have left the crop in a sorry condition.'

'August 1.—I send you today a last specimen from my potato plot. They have evidently been killed by a fungus. I first noticed its effects about a week ago on one corner, and it has since spread over the whole piece. Very few aphides are left alive. Since I last wrote, I noticed larvæ of lady bird beetles and of *Syrphus* flies; but neither of these or anything else had much effect in reducing the numbers of the plant lice until this disease appeared. A month ago my potatoes could not have looked more promising. Today I tried them, and out of 6 average hills I got 17 tubers, of which 2 only were large enough to be marketed.' —C. A. Hamilton."

In view of so extended and injurious an infestation of one of the chief crops of Maine for 3 consecutive years, it seemed desirable to ascertain whether there might not be some practical method of treatment or prevention. The standard remedy for plant lice—kerosene emulsion or whale oil soap spray—did not seem advisable for several reasons. By the time the plant lice have colonized the vines to an extent great enough to be particularly noticeable, the damage is already half done and the winged generations which develop at the time the potato tops grow sickly, leave the plants they are on for fresh vegetation. The proposition of spraying 40 acres of potato vines with kerosene emulsion late in August for instance when the wing pads which bespeak the migrating generation are already in evidence would not appeal to the large potato grower. To apply such a spray before the infestation became excessive, while it would kill many of the scattered plant lice, might on the other hand be a sheer waste of energy, for the amount of injury which plant lice are going to inflict is a matter not fairly open to prophecy, so many elements of uncertainty enter in. The weather, for instance, plays an important part in the welfare of plant lice, heavy rains washing the tender forms from the plants, and cold days retarding the rate of increase. A long stretch of damp weather is favorable to fungus parasitism which may sweep out the plant lice from a large area. Then, too, in certain seasons, predaceous and parasitic insects appear in numbers sufficient to render any artificial remedial measures

superfluous. The efficiency of emulsion sprays for plant lice has too long been known to make plausible any attempt for any other direct treatment in this case. But to be successful an emulsion spray since it kills by contact would need to be forced under the infested leaves as well as along the tip of the stem and between the buds and flowers where the plant lice are particularly crowded. Just what the results of such a treatment upon the potato might be is a problem which concerns the plant pathologist, and while the fate of the insects subjected to such a treatment would be satisfactory to the potato grower, whether the fate of the vine would be equally so is a matter which would require careful tests to decide.

The standard remedy for plant lice, in short, seemed not available for the situation in question.

The alternative was the study of the life history of this species with a view of ascertaining the alternate host plant and if practicable eradicating it or controlling its growth within the vicinity of potato fields.

A Generalized Life Cycle for Nectarophora.

In order to outline the need of such a study with a given species of plant louse whose life history is not known, the life cycle of plant lice in general is here briefly sketched. Although the life cycle varies greatly within the range of Aphididæ, the family of plant lice, the following are the points drawn from related forms which seemed of significance with the life cycle of *N. solanifolii* in view.

In the north such a plant louse may be expected to winter in the egg stage. From the egg emerges in the spring a wingless form which is commonly spoken of as the stem mother. The stem mother does not deposit eggs but produces living young, and is the first of a long series of forms designated on this account as viviparous females. The young plant lice begin at once to feed upon the sap of the plant and in 8 or 10 days produce offspring. The first few spring generations may be wingless or at any time winged individuals or an entire winged generation may appear and fly away to fresh plants and there start new colonies where a succession of generations are produced as before. Such a winged generation is called the

migrant generation and with many species the migrants desert the host plant upon which they have been feeding and seek a plant of an entirely different species. Thus the plant louse destructive to hops passes part of its life cycle upon plum trees. This alternation of hosts is a point in the life history of Aphididæ of great economic significance, for it sometimes happens that a species can be controlled on one plant and thus its attack upon the alternate host be prevented.

After spending a few weeks or a few months upon the second host plant, winged individuals called fall migrants appear and return to the same kind of plant, the winter host, upon which the stem mother and the spring generations had lived, and there continue the series of generations. Up to this time no males have appeared and all of the forms, whether winged or wingless, have been females giving birth to living young as was the case with the "stem mother." But after the fall migration they are likely to develop the true sexes, males and egg-laying females. These oviparous females deposit a few comparatively large eggs, in which stage the insect winters and from which the stem mothers hatch in the spring.

It is some such outline as the foregoing to which a species whose life history is unknown must be referred as a working basis. Any variation of the general life cycle of the plant lice, however, is never a fair cause for surprise. One is quite likely to find, for instance, that a certain species does not pass the winter in the egg stage but as a subterranean form at the roots of some plant.

The difficulties as to life history studies presented by the alternation of host plants common among the Aphididæ are augmented by the fact that certain differences in structure, great enough to count as specific if occurring in other families of insects, are common in different generations of a single species of plant louse. It not infrequently happens, therefore, that the same species may, when found upon different host plants, be recorded as two or more distinct species and their identity not suspected for years. Also, 2 actually distinct species may resemble each other so closely in certain forms that they are easily mistaken for one species. Moreover the specific characters of the genus Nectarophora have not been systematically determined.

Any work, therefore, either systematic or ecological, undertaken with this genus should be pursued with the idea that it shall in some way lessen instead of augment the confusion which already exists with this group of plant lice. The observations recorded for *N. solanifolii* in the present bulletin are meagre but they all unquestionably refer to the single species under consideration. It seems advisable to tabulate such facts as have been ascertained now rather than to wait for the accumulated observations of a longer period for 2 reasons. The economic point involved—that is, whether *N. solanifolii* might practically be combated upon its winter host—seems to be answered by the evidence now at hand. Then, too, over those parts of the State which were under observation this season, *N. solanifolii* upon the potato was apparently so nearly exterminated by fungus parasitism that it is probable that some time will elapse before this species again appears in the State to an extent great enough to make further work with it practical.

Nectarophora Solanifolii from Field Observations.

The points which were evident for this species in Maine from field observations upon the potato for the 3 seasons 1904-1906 were that about the middle of July a very few scattered individuals may be seen upon the potato; that before the last of August the infestation may become excessive, the tips of the stalks, flower stems and terminal leaves being packed with plant lice; that by the middle of September the fall migration is over; and that the migration takes place before the true sexes appear, neither the oviparous female nor the male occurring upon the potato in the field. The points in the life history which were not known and concerning which it was desirable to obtain data were upon what plant the spring generations lived; whether this Nectarophora would accept more than one host beside the potato (that is, whether it was a "general" or a "specific" feeder); whether the true sexes appeared in the fall, and if so where the eggs were deposited.

A few dates may be quoted here for instance.

August 11, 1904, Houlton.—A correspondent who had been much worried by a bad infestation sent in a box of *N. solanifolii* mostly winged or within one molt of being winged with the comment: "I do not find

nearly so many on my vines as I did a week ago. The blossoms are about all gone from my potatoes and the small stalk on which the blossoms grew is a dirty brown color and seems to be withering up."

August 17, 1905, Houlton.—The writer found *N. solanifolii* excessively abundant over about 20 acres. The stalk tips were crowded with viviparous forms both winged and wingless, and in many cases the flower stalks were dead.

August 25, 1906, Houlton.—Potato stem tips and leaves literally packed with *N. solanifolii*. Much injury to the potato tops evident.

July 18-19, 1905, Houlton.—A 2 days' careful search in 4 large potato fields (one of which is the field for which the foregoing record of August 17, 1905, is made) resulted in the finding of but one specimen of *N. solanifolii*. That single specimen was a wingless form and there were 3 lady-beetles after it.

July 18, 1907, Houlton.—A large field that had been heavily infested the previous August was examined. A very few scattered individuals were found on the blossom stalks of potato. A most thorough search for some distance over many rows revealed not more than an average of a single specimen to 3 rods. These were wingless viviparous forms sometimes apparently still too young to start a colony and sometimes mature and accompanied by a very few progeny. No winged form was seen on this date.

July 24, 1907, Kennebunkport.—*N. solanifolii* present upon potato but very scattering and chiefly wingless. A single winged specimen taken.

July 25, 1907, Farmington.—*N. solanifolii* present upon potatoes but very much scattered.

July 31, 1907, Houlton.—(Same field as foregoing record for July 18, 1907). *N. solanifolii* nowhere numerous, yet present all over the field. A single wingless, viviparous form with progeny on every third and fourth hill and winged viviparous forms with progeny found here and there, but less common than the wingless forms. A few individuals whose wing pads indicated they were but one molt from maturity taken on this date would indicate that these winged forms present did not come as migrants but had developed as progeny of the wingless forms noticed earlier in the month.

September, 1906, Houlton.—Early in the month the fall migrants acquired wings and deserted the potato. On September 14 only 4 or 5 belated specimens were found in a day's search in several fields where the infestation had been excessive in August. No males or oviparous females were seen upon the potato in the field during the 3 years though frequent searches were made. Although the infested fields were visited once or twice weekly for nearly the entire season, further quotations from the field notes for 1907 are omitted here because on account of continuous and heavy rains the species were held much in check and also because later practically the whole infestation was killed out by a fungus parasite, the natural increase of the species being prevented by either cause enough to make the field notes for the present year exceptional rather than the rule.

Insectary Observations.

During the summer of 1906 this species was bred in the insectary upon potato, but as various other species were under observation in the same house and as two species of the genus Aphis colonized the potato there to an extent which interfered with the work with *N. solanifolii,* little reliable data was obtained. For the season 1907 particular precautions were taken. During the entire summer no plants were grown in the insectary except such as were started there from seed—that is, no risks were taken as to the introduction of any other species of plant louse upon plants. A single exception was made when the house was stocked with shepherd's purse, but for this purpose very young plants were used and these carefully examined. It should be stated that during the entire time of the observations upon these plant lice the insectary was not heated in any way, so that the temperature conditions were not so widely different from those out of doors, that this element need come in for consideration. It was, however, possible for the insectary colonies to breed unchecked by rains, predaceous or parasitic insects, though a fungus parasite was introduced in August which seriously interfered with the uncaged material.

The few specimens obtainable (see field notes for Houlton, July 18, 1907) were placed upon potato plants in cloth cages in the insectary July 19; July 22 they were increasing rapidly, many had molted and all seemed healthy. Some such interesting data were obtained from the material started at this time that quotations from notes made upon them are here included. These specimens and their descendants, caged in cloth cages from July 19 to September 20, were protected during the entire time from the fungus which was introduced in August with uncaged material and which spread through the insectary.

August 3, 1907. Insectary.—The progeny of the wingless viviparous lot taken at Houlton July 18 are winged viviparous forms. The stalks this lot have been colonizing since July 18 are speckled with beak wounds. The plants have a general unhealthy appearance and the leaves are sticky with honey dew and somewhat attacked by honey dew fungus.

These winged individuals left the sickly potato stalks upon which they had fed during the earlier stages of their lives and rested upon the cloth sides of the cage which confined the potato. These winged forms were removed from the cloth and placed in lots of 20 each under cages upon fresh potato previously uninfested. They settled at once, remaining upon the fresh stalks.

August 5. None of the transferred specimens have left the new plants. They are feeding and producing young actively and not a single individual is to be seen upon the cloth of these new cages, all signs of the restlessness evinced in the old cage having left them. It seems reasonable to suppose that their desertion of the plants upon which they had been reared was caused by the unhealthy condition of these plants due to the two weeks presence of the plant lice. Provided with fresh plants they were content. It is probably due to this migrating instinct that makes possible the even infestation of a whole potato field,—the first winged forms developing upon stalks over crowded and consequently sickly, seeking uninfested tips for their own feeding places and for their progeny.

August 13. The progeny of the foregoing winged viviparous forms are partly wingless viviparous forms and partly, as indicated by wing pads, to be winged viviparous forms. The colonies do not seem particularly vigorous. The plant tips are badly speckled with beak wounds and the leaves a little discolored with honey dew fungus.

September 20.—The material recorded August 3 and August 13 was in the case of 2 cages left unmolested until today when both the true sexes are found to be present. The males are winged. The females are wingless. Further description of these forms is reserved for another place.

September 21.—About 8 males and some 20 oviparous females were removed from the potato and placed upon a young shepherd's purse plant in a cloth cage. Females were added from time to time and a very few males. From September 21 to October 11 from one to 3 pairs of these were noticed in copulation each day. On October 11 examination of the sheperd's purse showed Nectarophora eggs variously placed on the upper and under sides of the leaves and along the stem. One was deposited on a cheese cloth thread in the cage.

It should be emphasized here that although the true sexes developed upon the potato in the insectary and thereby showed that another plant was not a necessity for these forms, the situation was practically forced. A single caged potato plant had been stocked August 3 with 20 winged viviparous forms reared on potato from the wingless viviparous forms collected July 18 and left to them and to their progeny until September 20, there being no choice for the prisoners except the potato or death, for a period of 2 months. This period extended considerably past the season of migration for *N. solanifolii* in the field which had been observed to have occurred for 3 years early in September or late in August. The fact that the imprisoned insects then developed the true sexes upon potato is no indication that such would be the case in the open field. Indeed the fact that the true sexes did not appear until long after the season of out-of-door migration would rather indicate

that normally the winter host plant would be sought previous to the appearance of the males and oviparous females.

The objection that such forced conditions might have no bearing upon the normal development in the field might be a legitimate one except for the observations taken as a check upon material during this same time that had the liberty of the whole insectary and a choice of host plants. These observations are as follows:

August 16 about 80 perfectly healthy potato plants in the insectary were stocked with *N. solanifolii* collected at Orono and were left uncaged. By August 30 they were fairly represented by the photograph (Fig. 26) taken at that time. Later the stalks in most cases died to the ground and new shoots started up from the base. By planting potatoes in the insectary often the plant lice were kept supplied with fresh plants which were colonized by the individuals which deserted the plants they had rendered sickly.

August 31, 1907, Houlton, Maine.—In a buckwheat field adjacent to a potato field several colonies of *Nectarophora* sp. were to be found upon buckwheat tips. They were in all respects discernable by a hand lens the same as *N. solanifolii*. Both green and pink color forms were present but they were so seriously fungus attacked that by the time even the healthiest of the specimens could be brought to Orono, microscopic examination for comparison with *N. solanifolii* was unsatisfactory and breeding for winged forms was impossible.

August 31, 1907, Houlton, Maine.—From shepherd's purse *Capsella Bursa-pastoris* Moench. several colonies of *Nectarophora* sp. were taken. They were not to be distinguished from *N. solanifolii* by hand lens examination and both green and pink color forms were taken. They were badly attacked by fungus and by the time they reached Orono they were in no condition for further observations.

The suggestions given by these two collections was acted upon conversely, however, by sowing buckwheat among the potato plants in the insectary and transplanting about 200 young and clean plants of shepherd's purse into trays. Peas were also sown at the same time. By the time the buckwheat and peas were well up about 100 fresh potato plants were available, and the *N. solanifolii*, deserting the older potato stalks, colonized thoroughly the fresh potato vines, pea vines, and the shepherd's purse apparently with no preference. Both winged and wingless forms were found for the rest of the season rearing contented progeny upon potato, and shepherd's purse, and also upon the young pea vines until they killed them. Except for stray individuals which, of course, would be found upon everything in the crowded insectary, the buckwheat remained apparently untouched. Whether *N. solanifolii* would have accepted the blossom tips of the older buckwheat or not was not demonstrated as the buckwheat, although it lived, did not make much growth.

From the last of July, 1907, to October 11 (possibly later) both winged and wingless viviparous forms were present in the insectary. With the Orono material of August 16, individuals attacked by a fungus were inadvertably introduced, and the fungus spread among all the uncaged material keeping it so reduced in numbers there seemed danger of the insectary observations meeting the same fate as those of the field. However, every opportunity by way of freshly planted material was given them and the insectary was kept as dry as possible and enough of the plant lice escaped the fungus to keep the situation interesting.

September 23. After finding the true sexes upon the caged material, careful canvass was made of the uncaged plants in the insectary and numerous oviparous females (mostly still young) were found both upon the potato and shepherd's purse, although more numerously upon shepherd's purse. No males were found at this time and later but two were seen in copulation on the uncaged material,—one pair being upon shepherd's purse and one upon potato. The prevalence of the fungus undoubtedly prevented the development of a greater number of the true sexes.

October 11. Insectary search showed the *Nectarophora* eggs near some of the oviparous forms both upon potato and shepherd's purse. Many of the eggs were the glistening brownish black of well hardened eggs but some were pelucid green showing that they had very recently been deposited. They were upon the plants indiscriminately on leaves and stalks.

The appearance of the oviparous females and the deposition of eggs with the uncaged material at practically the same time as that of the forms that had been prisoners for 2 months would indicate that these dates are about normal. In the insectary the migration from overcrowded potato stalks to fresh plants seemed to take place irregularly and not at any stated times, the condition of the infested plant apparently influencing these movements. The fact that they seemed to seek the fresh potato plants almost as readily as the peas or the shepherd's purse might seem to indicate that if a similar succession of new potatoes were supplied them in the field they might not seek another host even there. As it is a wholesale migration has taken place each of the 3 seasons these plant lice have been under observation.

It seemed reasonable to expect that such an enormous number of healthy plant lice as had migrated from the Houlton potato vines late in the summer of 1906 might with careful search be located on the alternate host. After several long and tedious attempts during September, 1906, the writer, somewhat chagrined, postponed the search until the following spring in

hopes of finding them before the spring migration. During June and July, 1907, (until *N. solanifolii* appeared upon the potato) the search was continued until it seemed as though every species of vegetation within aphid flight of potato fields had been examined, but no *N. solanifolii* were chanced upon.

Two conditions noted July 18, 1907, were of considerable consolation in this connection. The first specimens observed on the potato at the date were very few—one to about 3 rods—a circumstance that might seem to indicate that the species was not numerous enough upon anything to make a wholesale migration necessary. A more puzzling fact was that the first forms seen were wingless and solitary except for their own progeny, and many of them had not yet begun to produce. There was in this no basis for suspecting that any migration in the usual sense, that is of a horde of winged forms, had taken place, but rather that restless individuals had crept over on to the potatoes from neighboring vegetation. No conclusive statement, of course, would be justifiable upon observations so limited, and these suggestions relative to the manner of migration are merely tentative. Insectary observations showed this species to be active and restless at times both in the winged and young apterous forms.

The Practicability of Combating N. Solanifolii Upon Its Winter Host.

Since for several consecutive seasons of excessive infestation of the potato, *N. solanifolii* has while upon its winter (and consequently late fall and early spring) host lived in such restricted numbers that it was, to say the least, nowhere conspicuous, it is evident that any measure directed against this species while upon its winter host is for Maine quite futile. The readiness with which the insectary material accepted pea vines and shepherd's purse lays this species open to the suspicion of not being confined to 2 hosts for Maine. Further tests as to the wider range of food plants would be of much interest and there is a possibility that a complete food list would contain some helpful suggestions. Insectary tests as to a wide range of food plants are contemplated as a part of the further study of this species. As an example of the possible significance of fuller host plant data may be cited the following

observation. After the insectary material was found to accept pea vines for colonization, the fact that it is the custom in Aroostook County to plant peas with oats as a part of the crop rotation including the potato was remembered. These pea vines are, of course, sheltered by the oats and as they are cut merely for fodder a summer infestation of aphids would, unless especial search was made, pass undetected.

In the vicinity of Houlton, September 11 September 16, 1907, search on the peas growing with oats was made and both winged and wingless forms of *Nectarophora* sp. apparently like *N. solanifolii* were found. Like the *Nectarophora* upon potato, shepherd's purse, and buckwheat, the species upon peas was too badly attacked by fungus to render much work with it possible.

In view of the fact, however, that the species upon the potato will feed and multiply readily upon pea vines (see insectary notes) it might be advisable, if the trouble continues to be seriously prevalent, to omit the peas from the rotation scheme. For potatoes upon numerous 20 to 60 acre fields one year and peas over the same area the next would seem to offer an unbroken opportunity for the growth of the summer generations of this destructive plant louse. This suggestion does not touch the question of the winter host, because it would be upon these vines as upon the potato that the summer generations would occur, and even if eggs were deposited upon the pea, as it is harvested with the oat crop it could not serve as a dangerous winter host.

Summary as to Remedial Measures.

1. The standard remedies for plant lice, emulsion sprays, do not seem practicable for the large potato crop of Maine.

2. No other direct remedy seems to be more available.

3. It is apparently futile to attempt to combat this species in Maine through the medium of the winter host.

4. Clean culture may legitimately be classed among the available preventive measures with this pest as with most crop pests. Since it has been ascertained that *N. solanifolii* passes the winter in the egg stage and that the eggs are attached to the leaves of its host, shepherd's purse and possibly various other

weeds, the practice of fall plowing commends itself in this connection and also the burning over of grassy and weedy spaces in the vicinity of potato fields. As it seems not impossible, although it has not been observed, that belated specimens might under certain conditions remain upon potato vines slightly infested and the oviparous females develop there, the custom common through Aroostook County of burning the old potato stalks to get them out of the way is commendable as a precaution.

5. If *N. solanifolii* continues to be a serious pest upon the potato it may be advisable to drop the peas from the rotation.

6. While under favorable conditions *N. solanifolii* is a serious pest upon the potato, there seems to be nothing better to advise by way of direct remedy than to leave it to its natural enemies, which sometimes, as the fungus of this present season, serve practically to exterminate it over wide areas.

7. The countless beak wounds inflicted upon the stalk and leaves must render the potato more susceptible to fungus and bacterial disease. Its presence, therefore, should emphasize the need of careful Bordeaux sprays.

Natural Enemies.

1. Weather conditions stand high among the controlling influences of aphid growth, heavy or continuous rains serving as a check.

2. Predaceous insects. Among these found feeding upon *N. solanifolii* in Maine may be mentioned 2 lady beetles, *Adalia bipunctata* and *Hippodamia 13-punctata*, and larvæ of syrphus flies.

3. Parasitic insects. Braconid parasites of the subfamily Aphidiinæ have been bred from *N. solanifolii* taken in this State.

4. Fungus parasites. Frequent mention has already been made in this bulletin of the work of fungus upon *N. solanifolii* at Houlton and also at Orono whence it was introduced into the insectary. Dead specimens from both localities were submitted to Doctor Roland Thaxter, who kindly identified the Orono species as *E. planchoniana* Cornu, and that from Houlton as the more common *E. aphidis*.

Fig. 25. N. solanifolii on potato stalk. Leaves covered with honey dew, honey dew fungus, and cast skins.

Fig. 26. Potato plant showing the result of 14 days infestation of plant lice on perfectly healthy stalks.

DESCRIPTION OF NECTAROPHORA SOLANIFOLII ASHMEAD.

It will be evident to anyone interested in Aphididæ that *solanifolii* is quite possibly open to the synonomic honors so common to the genus *Nectarophora*. As the question cannot be satisfactorily settled for this species without straightening out *N. pisi* (!) and perhaps all the other nondescript green and pink *Nectarophora*, the writer modestly though regretfully refrains from offering any elucidating suggestions, at present. Utmost care has been taken and will be taken in the future work proposed for this species, to be positive that the data recorded for *N. solanifolii* refers to one species only so that at least it may be certain that the observations add nothing to synonymic confusion.

A considerable mass of mounted material of this species collected during 1904-1905 was kindly determined through the courtesy of the U. S. Bureau of Entomology by Mr. Pergande as *Macrosiphum (Nectarophora) solanifolii* Ashmead. Doctor Fletcher acknowledges the same authority for the name of the species abundant upon potato in Canada mentioned in his report for 1904.

The original description made for specimens found on *Solanum jasminoides* for this species appeared in the Canadian Entomologist, Vol. 14, 1882, pages 92-93, and may be quoted for the apterous viviparous form:

"*Siphonophora solanifolii* n. sp.

"Wingless female.—Length .12 inch. Elongate ovate and of a pale yellowish green color; beak short, not reaching middle coxæ, pale, tip black; antennæ 7-jointed, slightly reaching beyond abdomen, situated on large tubercles, pale greenish, joints infuscated, 6th joint shortest, dark, 7th longest, brown; eyes red; honey tubes very long, reaching considerably beyond abdomen, slightly thickened at base, infuscated at tip; style short, conical, greenish, coxæ shining and yellowish, feet black."

Mistake as to the identity of the so-called male is evident from the original description of this form and is therefore omitted. "Antennæ hardly reaching to middle of abdomen" and "honey tubes rather short" could not, in light of further acquaintance with this form, be expected to apply to a male of the genus under consideration.

In general *N. solanifolii* is a large, active species, usually green but very often pink, and sometimes yellowish, especially the young of the pink individuals.

Decidedly pink individuals occur both with the winged and apterous viviparous females. At Houlton, August 17, 1905, a pink-winged viviparous female was taken with 12 young, 7 of which were decidedly green and 5 decidedly pink. About 20 pink viviparous specimens collected at Maple Grove, August 18, 1906, were placed upon potato in the insectary. Some were winged and some were apterous. On August 29 the young of these were all found to be pink, though many were toning into pale yellow.

The insectary specimens of oviparous females were largely pink, though many were yellow, and a few distinctly green.

NECTAROPHORA SOLANIFOLII. *Winged viviparous female.*—Head yellowish green. Antennæ, proximal segments pale green, distal segments dark; length of segments: III, .88 to .96 mm.; IV, .76 to .9 mm.; V, .64 to .72 mm.; VI, .16 to .2 mm.; VII, .96 to 1.12 mm.; total length I to VII, 3.6 to 4.05 mm. Prothorax and thorax light yellowish green. Wings hyaline, veins dark brown, very slender, stigma pale brown. Total wing expansion 8.1 mm. Legs with proximal part of femora and tibiæ pale, tarsi and distal part of femora and tibiæ dark. Tarsi .16 to .2 mm. Abdomen light green unmarked dorsally or ventrally. Cornicles, with proximal portion green, and distal portion dark brown, inbricated, cylindrical, length .95 mm. or about 5 times length of tarsus. Style light green, ensiform, length .48 mm. or about one-half length of cornicles.

Total length of body to distal tip of style and exclusive of antennæ, 2.9 to 3.37 mm.

Winged viviparous female, pink individual.—Head light yellowish. Antennæ with I and II light yellowish, rest dark. Prothorax and thorax light yellowish pink. Abdomen pale pink. Cornicles light yellow with tips dusky. Style pink.

Apterous viviparous female.—Color as with the winged viviparous form. Antennæ, length of segments: III, .8 to .96 mm., IV, .72 to .88 mm., V, .56 to .72 mm., VI, .16 to .2 mm., VII, .96 to 1.2 mm.; total length of segments I to VII average about 4.05 mm. Cornicles .96 to 1.04 mm. in length. Style .56 mm.

Total length of body to distal tip of style and exclusive of antennæ, 4.05 mm.

Apterous oviparous female.—Head pale, nearly white. Antennæ with proximal joints pale, distal half dark. Length of segments: III, .68 to .88 mm.; IV, .56 to .68 mm.; V, .52 to .64 mm.; VI, .16 mm.; VII, .96 to 1.04 mm.; total antennæ length I to VII average about 3.6 mm. Prothorax and thorax pale like head. Legs with femora and tibiæ, proximal portion pale, distal portion dusky. Tarsi dark, .16 mm. long. Hind tibiæ conspicuously darker and much swollen and thickly set with senoria. Abdomen light salmon pink. Cornicles pale at base, distal half dark; length .6 to .8 mm. Style salmon pink, ensiform, length .32 to .4 mm. Total body length to tip of style, antennæ excluded, 2.13 to 2.15 mm. The size of the hind tibiæ of this form makes it readily distinguished from the apterous viviparous form and young, even to the unaided eye.

The pink variety has been described because these predominate. The color scheme of the green and yellow forms can be determined merely by substituting these colors for the salmon pink of the individual described, the dark coloration being the same for all 3.

Winged male.—Head and antennæ dark brown. Length of antennal segments: III, .72 to .8 mm.; IV, .48 to .64 mm.; V, .48 to .6 mm.; VI, .16 mm.; VII, 1.04 to 1.28 mm.; total antennal length I to VII, 2.93 to 3.60 mm. Prothorax and thorax dark brown. Wings deflexed, hyaline, veins dark and very slender, stigma pale brown. Legs brown, darker at tips. Abdomen brown. Cornicles pale brown, dark distally, cylindrical, .48 to .56 mm. long. Total body length exclusive of antennæ and cornicles, 1.12 to 1.57 mm. The thorax is large and strong to support the wing muscles, the abdomen much shrunken and is rendered conspicuous only by the comparatively (for the size of the body) long cornicles. The male is described from specimens observed in copulation, in order that no mistake as to the identity of the species might occur.

Explanation of Plates.

It will be seen from the accompanying camera lucida drawings that *N. solanifolii* is a fairly typical *Nectarophora* as regards antennæ. Although the number of sensoria varies somewhat within the limits of each of the four forms, the segments figured are representative. The antennæ of the apterous viviparous and oviparous females most closely resemble each other, segment III sometimes having 4 sensoria for each form, though the number is more commonly as figured. The number of sensoria is not constant for the winged viviparous form, there frequently being a few more than occurred in the specimen drawn, but they are in all cases arranged in a somewhat irregular row. As is usual for Aphididæ the antennæ of the males are conspicuous for the great number of sensoria present, giving a very uneven outline. Segment V characteristically bears sensoria not found in the other sex. Although the antennæ of the male are not actually so long as those of the females, they are, relative to the total length of the body, much longer, being in this sex more than twice the length of the body.

Fig. 27, winged viviparous form, Antennal Segment III.
Fig. 28, apterous " " " " " III.
Fig. 29, apterous oviparous " " " III.
Figs. 30 and 31, winged male, Antennal Segments III, IV, V.
Fig. 32, viviparous form, Basal ⅔ of hind tibia.
Fig. 33, oviparous " " ⅔ " " "

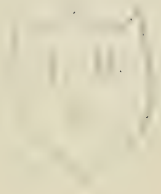
Fig. 27.

Fig. 28.

Fig. 29.

Fig. 30.

Fig. 31.



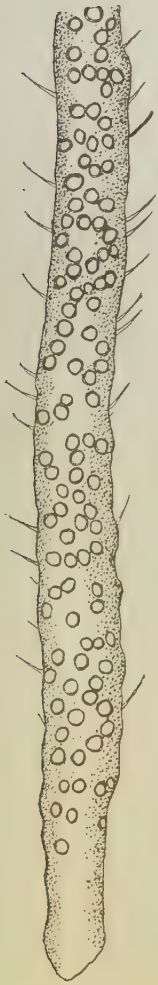


Fig. 33.

Fig. 32.

Fig. 34. The Carolina locust, killed by fungus, *Entomophthora grylli*. The specimen figured was collected at Orono, September 5, 1907. See page 270.

INSECT NOTES FOR 1907.

EDITH M. PATCH.

The annual bulletin published under the title of Insect Notes is a record of such insects of Maine as come particularly to the notice of the Station during the season. It is not designed primarily as a remedial measure bulletin, as advice of this character is sent largely to suit the individual needs either by personal correspondence or wherever possible by popular economic circulars which are kept constantly in print for this purpose. For notice of the species recorded in Insect Notes we are in a great measure indebted to people all over the State who send specimens for identification which are frequently of much interest. Although the Station would be glad to keep in touch with the insect life in every part of the State, its entomological work is often concentrated for an entire season in a few places and thus for information concerning local outbreaks we are dependent many times upon data volunteered by correspondents. To those people who have thus aided the Station for the current year, the present bulletin is in itself an acknowledgment.

Where definite lines of work are in progress, notes upon insects outside these definite lines must be more or less incidental and the most significant of these are brought together annually in a bulletin of miscellaneous Insect Notes.

THE GIPSY AND BROWN-TAIL MOTHS.

The two insects most to be dreaded in the State, the brown-tail and the gipsy moths, are discussed so fully in so much easily available and widely distributed literature* that they are merely mentioned here by way of constantly keeping the danger from them in mind. The success with which they have been so far combated in places in which they have been most numerous in this State should in no wise serve as an excuse for less vigilance, but rather as a stimulus to the continuation of the most rigid measures. Any temporary negligence with either

* Maine Agr. Exp. Sta. Circulars and Bulletins; Maine Dept. of Agriculture, Augusta, Circulars and Bulletins; U. S. Bureau of Entomology, Washington, D. C., Circulars and Bulletins.

of these insects will inevitably bring disaster with the necessity of combating them over ever increasing areas at enormous expense.

Forests Attacked by One of "The Prominents."

Heterocampa guttivitta Walk.

For a distance of more than 40 miles across Southern Oxford, Cumberland and Androscoggin Counties, a caterpillar invasion swept clear of foliage much of the forest growth over large areas. The complaints were numerous about the middle of August. A correspondent from Wayne wrote: "These caterpillars are on all the maples in this section and stripping the foliage." From West Bridgton another said: "They are ruining the hard wood growth in the forests of Fryeburg, Sweden, and of a part of Bridgton." A resident of Bridgton reported them as "very plentiful here and devastating certain sections of the forests. They seem to prefer the beech trees, though they also are found on maple and apple trees." Specimens accompanying all these and various other reports all proved to be the same species, *Heterocampa guttivitta.*

August 15 and 16, South Leeds and Upper Gloucester were visited by the writer. At Upper Gloucester a beech forest was stripped as bare of foliage as winter trees. The insects for the most part were full grown and buried for pupation. By lifting back the top of the leafy soil from 1 to 3 inches the freshly formed pupæ and newly buried larvæ were found to be thick. The cocoon was very slight and was torn in disturbing the soil.

Numbers of Carabid beetles were searching about the bases of trees, most conspicuous among which, probably, because of its size, was the Fiery Hunter, *Colosoma calidum.* The predaceous bug, *Podisus modestus* (shown in Fig. 44) was particularly active. This species in both larval and adult stages was found in considerable numbers on the trunks of the trees sucking the blood of wilted looking caterpillars which they had stabbed. At the bases of many of the trees were little heaps of dead and half sucked caterpillars, while the group of *Podisus modestus* just above and still at work on other victims showed the cause of their condition. At South Leeds these caterpillars had entirely stripped a beautiful hard maple grove and were at work rid-

dling adjacent beeches. The larvæ here were not quite full fed and the sound of their jaws together with that of falling bits of leaves and castings was like the sound of a rain storm. They were also at work on oak and apple at South Leeds but not to such an extent as on the maple and beech.

The larva resembles closely *H. manteo* and *H. bilineata* and the species was not definitely determined from this form. By keeping the pupæ moist and warm in the laboratory, however, adults began to emerge Dec. 3, 1907, and these were kindly determined by Doctor H. G. Dyar as *H. guttivitta* Walk.

The specimens taken in Maine this season presented the greatest variety of dorsal color patterns in white, green, and brownish purple. All the color variations faded in the full fed larvæ, however, and before pupating the body of the caterpillar was dull green with almost all trace of other color obliterated except the dark side lines of the head. Three specimens are shown in Figs. 39, 40, 41.

The weather in the southern part of the State, unlike the rest of Maine was very dry this season and seemed to be particularly favorable for caterpillar growth. Numerous other species were at work during August and the "green striped maple caterpillar," *Dryocampa rubicunda,* defoliated maples in certain localities. See Fig. 38.

Forest Tent Caterpillar.

The Forest Tent Caterpillar, *Clisiocampa disstria,* has been in the increase in the State for 2 seasons, especially in the vicinity of Blaine and Mapleton, and though it is not yet very generally troublesome, it seems to be getting ready for one of its periodical outbreaks. A circular of information is in preparation for this species in order that the danger may be appreciated in localities where this caterpillar is gaining ground. The devastations of the forest tent caterpillar of 1889 and 1890 * are plainly remembered by people living along the Penobscot and in the vicinity of Seboeis, who still refer to "the caterpillar year."

* Me. Agr. Exp. Sta. Report 1889, p. 188; 1890, p. 138.

Orchard Tent Caterpillar.

The large percentage of dead eggs of the common orchard tent caterpillar, *C. americana,* was noticed this season by even casual observers. This species was exceedingly numerous during 1906 and in certain Orono orchards as many as 5 to 20 egg clusters to a tree were found in the spring.

Following is the hatching record of 24 egg masses collected in April before any eggs had hatched:

Egg mass No.	Eggs Hatching.	Egg mass No.	Fggs Hatching.	Egg mass No.	Eggs Hatching.
1	0	9	0	17	41
2	0	10	0	18	138
3	0	11	92	19	4
4	0	12	93	20	96
5	0	13	0	21	108
6	0	14	64	22	0
7	0	15	123	23	5
8	0	16	26	24	134

This gives a total of 927 caterpillars to 24 egg masses, a number which would ordinarily be equaled by 4 or 5 egg masses.

The peculiar weather of the past winter may perhaps be held accountable for a share in this condition, not so much because of the excessive cold but because of the sudden changes occurring. On Jan. 16 the temperature swung from a maximum of 21 degrees above zero to a minimum of 40 degrees below zero the following night, making a range of 61 degrees in less than 24 hours. Jan. 21 the temperature ranged from 47 degrees above zero to 13 degrees below. It seems probable that a winter unusually long and severe with sudden fluctuations in temperature would be perilous for insect eggs exposed upon the twigs of trees as are those of the tent caterpillar.

Cherry-Tree Tortrix, *Archips (Cacœcia) cerasivorana.*

The "ugly nests" filled with little yellowish, black-headed caterpillars have been very numerous for several seasons, on wild cherry for the most part, though sometimes on apple and raspberry. One colony just hatching from the eggs was collected at Portland June 20 on chokecherry. These were reared in the insectary on apple leaves. The moths which developed from this colony had mostly emerged by August 6. A colony

just hatched on wild cherry at Orono June 12 was likewise bred on apple leaves and the moths emerged August 5-12. As is often the case with an insect which has for several seasons been particularly numerous, the cherry-tree tortrix has been this season attacked by various insect parasites.

Of the hymenopterous parasites, *Pimpla conquisitor* was taken at the ugly nest of this tortrix at Portland, July 23. *Exochus albifrons Cr.* were reared from ugly nests received from Otisfield, Maine. *Labronchus** sp. were reared from ugly nests from Otisfield, Waldoboro and Orono. *Macrocentrus** sp. were reared from nests from Waldoboro and Orono. A dipterous parasite, *Dichætoneura leucoptera* Johnson, emerged in great numbers from ugly nests from various localities.

One of the solitary wasps, *Odynerus* sp., was observed on the nest of this tortrix at Kennebunkport July 24. It had captured a full grown larva and with its jaws grasping the caterpillar just back of the head, was preparing to take flight. The larva was limp and helpless.

Archips fervidana Clem., the oak ugly nest, was reported this year as last from Mt. Desert Island. September 8 a correspondent from Southwest Harbor stated that from one to several of these nests were in every oak and that the caterpillars were denuding the oak groves rapidly. Some of the same species of hymenopterous parasites which were present with *A. cerasivorana* emerged from Mt. Desert nests of *fervidana*. *Dichætoneura leucoptera* Johnson and one other dipterous parasite were also bred from *fervidana*.

Orchard Insects in Maine.

There is probably no reason so far as insects are concerned why apple raising should not be as profitably carried on in Maine as in other parts of the country. The conditions are, however, in many places far more promising at present for the production of insects than apples. Almost unbroken lines of neglected and therefore dangerous apple trees stretch for miles along the roadsides, scattering ungathered windfalls as

* For the determination of these two hymenopters as well as about 20 other insects appearing in this bulletin, which were not named in the Station collection we are indebted to specialists in the United States Bureau of Entomology, through the courtesy of Doctor Howard.

food for apple maggots, curculio grubs, and larvæ of codling moths. There is rarely a farmyard in which a few apple trees have not been planted and then in many cases left undisturbed as food for whatever insects chance that way. Wild cherries and hawthorn as well as native apples are permitted to grow within insect flight of cultivated apples and form entirely satisfactory breeding places from the standpoint of orchard pests. Paramount inducements are thus offered for every apple pest that can endure the climate. In the face of this cordial standing invitation to apple insects, there is many an orchard owner in the State who is grumbling because the invitation is annually accepted, and who has about decided that there is not much use trying to get perfect apples enough for his own family use.

There is a panacea for most of this trouble to be found in clean culture, by which is understood in part the clearing out of worthless trees, both cultivated and native, that serve as breeding places for orchard pests; the proper pruning and spraying of all apple trees not cut down; the tilling of orchard soil to disturb insects hibernating or transforming there; and the persistent destruction of windfalls.

The difficulties in the way of securing clean culture are not so serious for the man who depends upon his orchard for his income, for he would, of course, expect to supply himself with the necessary help and equipment. But the people who are engaged in other occupations and have only a small orchard, or a few favorite trees, cannot always conveniently give their trees the necessary attention. There is probably no neighborhood nor any grange in the State, however, which could not find one capable man who could be induced to care for the trees in a certain locality. The utterly hopeless conditions which small orchards present all through the southern part of the State would seem to offer a perfectly practical proposition for cooperation. Any grange or neighborhood could easily afford the spraying equipment.

The great economy of time and energy made possible by some such arrangement is apparent, for it would necessitate but one person making an effort to become acquainted with the dangerous insects, their vulnerable points and remedial measures instead of 20 or 30 to do so.

The number of insects which occur upon any one species of tree is likely to be excessive. The number of determined spe-

cies of oak insects, for instance, recorded by Packard * is over 400 for the United States, and he estimates that "it is not improbable that ultimately the number of species of oak insects for the United States will be between 600 and 800 or even 1000," when they are all determined. Yet oaks still grow! And even if there should prove to be 1000 species of insects which occur upon the apple, apples could probably still be grown and with care still be grown for profit as well as pleasure. But as a matter of fact the insects which are doing real damage to apple orchards in Maine at present are very well known so far as their life histories and remedial measures are concerned and there is not one among them that is not practically combatable if fought consistently over a considerable area. This could be done by each man taking care of his own trees, or much simpler by some system of cooperation by which one man could direct the care of trees on a given locality. It does not come within the intention of this bulletin to recommend the manner of such cooperation. It might be accomplished in various ways—through the grange, by a neighborhood club, or if the sentiment of the town supported such a movement, local measures could be secured against any neglected apple tree as a public nuisance and a danger to the orchards in the vicinity.

In view of the fact that the apple crop is one of the chief interests of the State, the Maine Agricultural Experiment Station has constantly had the orchard in mind with reference to insects of economic importance. The majority of inquiries which are received accompany insects found upon apple trees. In order that fuller information may be sent in reply to such inquiries than could be possible through a personal letter, illustrated circulars upon about 30 orchard insects most common in the State are kept in print for use in correspondence, and are sent as replies to persons submitting these insects for identification.

With this economic literature available for distribution to anyone in the State at any time, it hardly seems necessary to repeat annually extended bulletin notes upon such standard orchard pests as the red humped caterpillar, the yellow-necked caterpillar, the tiger caterpillars (*Halisidota caryæ* and *H. macu-*

* Forest Insects, page 48.

latus, the fall web worm, the tussock caterpillar, the tent caterpillar, the bud moth, the codling moth, the apple maggot, and others, unless some such unusual condition arises as a peculiar parasite invasion or an unwonted increase which should, of course, be noted.

While the available circulars include only a small number of the multitude of apple insects, yet if the orchards are so treated as to combat the serious pests, the multitude of lesser evils need not be feared, for they will for the most part succumb incidentally to the treatment given to the really dangerous insects and thus many species may be killed with one treatment. Moreover the remedial measures against the standard pests overlap. For instance, the destruction of windfalls by pasturing an orchard with hogs is a measure directed at once against 3 of the worst apple insects in the State—the apple maggot, the curculio and the codling moth. Or removing colonies while young and still gregarious includes the red humped caterpillar, the yellow-necked caterpillar, the tiger caterpillar and others, all of which occur upon the trees during the same time. In a similar way, because arsenical sprays are recommended for a multitude of orchard pests, it does not mean that the sprays need be applied a multitude of times each season.

Much study has been put upon these orchard pests by economic entomologists all over the country, but that avails the orchards nothing unless the orchardists make practical use of the resulting suggestions. Experiment Stations have repeatedly demonstrated the value of spraying for the codling moth, yet it is optional with the owner of the trees whether he shall profit by those demonstrations or not. It has been known for 18 years that a consistent and persistent destruction of infested fruit would practically exterminate the apple maggot, and the apple maggot is working in many parts of Maine as much havoc now as it did 20 years ago.

It is due orchardists of the State that the insect pests upon so important a crop should be studied for the purpose of finding what can be done by way of combating them. It is no less due orchardists of the State that careless owners of neglected trees should somehow be induced to contribute to the health of orchards in general by either caring for their own trees or cutting them down.

If the well known and constantly recommended remedial measures against orchard insects of Maine were to be applied in good earnest, the standard apple insect pests of Maine would diminish in a wholesale and satisfactory degree. And this is a matter that rests with the owners of trees. Merely by way of comment it might be stated that in certain localities where it has been known for 15 years or more that the apple maggot (or "railroad worm") must be fought by the destruction of infested fruit, it is not unusual to hear some such remark as "Now, there's that high top sweeting. I haven't had an apple to eat from that tree for five years. The railroad worm gets them all." And while season after season the infested fruit is permitted to lie and rot undisturbed upon untilled sod beneath the tree, the railroad worm is actually blamed for continuing to breed in conditions rendered ideal for that very purpose. The full humor of the situation is forthcoming when the owner of the high top sweeting complains of his neighbor for rearing curculios in his apples "to infest all the apples in the vicinity," though just what difference it makes whether the railroad worm or the curculio gets the fruit is not apparent. However, merely by way of interesting information the neighbor's attention is called to Fig. 35, which presents a curculioed apple. If raisers of such deformed fruit would pasture their orchards with hogs they would destroy the curculios which are a menace to the neighborhood and incidentally some of the descendants of the railroad worms which have migrated from the high top sweeting across the way.

Grasshoppers.

The summer of 1907 has been conspicuously a grasshopper season. Many species were more abundant than usual, but the red-legged locust, *Melanoplus femur-rubrum,* was, so far as observed, guilty of most of the serious trouble. They were present over a large part of the State all summer in troublesome numbers, but most of the complaints were made in August after the grass was harvested, when they were to be started up in clouds. Potato fields, large orchards, raspberry and blueberry bushes, as well as a great variety of other vegetation suffered. The "Carolina locust," *Dissosteira carolina,* was very common, but this species together with many other of the grass-

hoppers fell victims to the fungus *Entomophthora grylli,** during late August and September.

Figure 34 shows one of these grasshoppers in the position characteristic of victims of the grasshopper fungus. In low meadows the work of this same fungus was particularly to be observed with certain of the *Tryxalinæ,* as many as 4 or 5 dead grasshoppers being found clinging to a single grass stem. One of the invariable symptoms of this disease is evinced in a tendency to climb and to cling, and the dead grasshoppers remain clinging to the tops of grass heads or weeds until beaten off by storms. The sick grasshoppers when disturbed do not jump but instead climb a little higher and clasp their legs a little tighter about the plant they are on.

Except in the southern part of the State, the season was very wet, a condition which favored fungus parasitism among much of the insect life, hairy caterpillars and plant lice as well as grasshoppers being especially susceptible.

Beetles.

Buprestids.—Chief among the Buprestids of the season is *Brachys ærosa* Melsh. June 15, 1907, everywhere in the vicinity of Portland the adults of this species were common, feeding greedily upon the leaves of various trees. Collections were made from *Alnus incana,* oak, hazelnut, wild rose, elm, hawthorn, birch, cherry, *Amelanchier,* hazelnut and willow, the leaves of all of which they were skeletonizing, though they were most abundant upon the first four mentioned. As many as 12 to 20 of these bettles were common upon a single leaf of alder or oak. Their bright metallic colors made them conspicuous in the sun. At the slightest jar they relaxed their hold and slipped to the ground. They were not taken in large numbers in other parts of the State, though a few were found at Orono and elsewhere during June. This species in the larval stage is a leaf miner.

The strawberry weevil, *Anthonomus signatus,* is apparently widely distributed throughout the State, although strawberry growers have not complained of their presence to any great extent on cultivated plants. One large strawberry crop a few miles out from Farmington was practically destroyed by this

* Kindly determined by Doctor Roland Thaxter.

weevil this season, however. The weevils were collected in considerable numbers also near Houlton, June 28, 1907, about the blossom buds of wild red raspberry. Some of the weevils were inside the buds depositing eggs and others were observed to be nibbling at the bud stem, causing the buds to wither, as is their custom.

The Rose Chafer, *Macrodactylus subspinosus,* continued to be as troublesome this year as last. From Clinton it was reported as destroying hens. Another correspondent sent specimens of this beetle with the statement that out of a flock of about 2000 chickens on free range nearly 400 had killed themselves in 5 days by stuffing themselves with these chafers. The birds averaged from 12 to 13 weeks, and in some cases part of the chafers with which their crops were packed were still alive after the death of the greedy chicken.

The Striped Cucumber Beetles, Diabrotica vittata, were so numerous this season at Orono that cucumber and squash vines suffered severe attacks. Lime, bug death, sulphur, red lead, or ashes heaped thick upon the plants kept the beetles from the upper surface of the leaves, but as they congregated cheerfully underneath and ate through the leaves to the application on the upper side, these remedies did not avail much. Turpentine or kerosene and land plaster when applied about the plants in sufficient amount to keep away the beetles, killed the plants. This may have been partly due to the fact that a heavy rain followed the treatment and beat the young plants down against the application. One man practically rid his field by going over his vines when they were very small and gathering and killing the beetles by hand. The beetles were so thick that thousands were readily killed in this way. After gathering the beetles for 3 consecutive mornings, the infestation was reduced to such an encouraging extent that the process was repeated 3 or 4 mornings more, when no further treatment was necessary. This was, of course, a tedious method, but it disposed of the beetles inside of a week, while a field a few miles distant where nearly all the remedies which have ever been recommended against this pest were tried on different plats, the beetles remained in extremely troublesome numbers for between 3 and 4 weeks, during which time the adults had deposited so many eggs that some of the vines wilted later in the season

from the larval attacks in the stalks. In these treated plats the fall generation appeared in October as numerously as in June and the Hubbard squashes were pitted thickly with holes in which the beetles feasted until the squashes, which were undersized anyway, were unpresentable for market purposes.

Macrops vitticollis.—Besides the flea beetles, *Dibolia borealis* Chevr., which riddled the plaintain leaves, *Plantago major*, all over the State, plaintain crowns were found to be excavated by numerous small beetle larvæ. Some of these were collected July 23 at Portland in order to secure the adult beetles. On August 26, 2 beetles developed which proved to be *Macrops vitticollis* Kirby.

Sawflies.

The birch sawfly, *Nematus erichsonii*, is again at work in Maine upon the larch or tamarack, or as it is more popularly known here, the "juniper." By August 8 the work was mostly in the vicinity of Houlton, but clusters of larvæ still remained here and there and it was gratifying to note that a fair percentage of these had attached to them the small white eggs of a Tachina parasite. The larvæ of *Cræsus latitarsus*, a sawfly common in the State, were received from Bar Harbor September 17, where they were attacking birch. The fir tree sawfly, *Lophyrus abietis* Harris, was present at Seeket, where it completely stripped some fir trees and spruce. Cocoons were received from this locality August 29 and September 10, and on the latter date cocoons of the same species were received from MacMahan, Sagadahoc County. The adults emerged from the middle to the last of September. This species also attacks the pitch pine, and seems to have a deplorable start in the localities mentioned.

An Ant Attack on Plant Lice.

June 12, a birch growth was visited where great numbers of a large and sprightly aphid, *Callipterus betulæcolens*, were to be found both in late pupal and freshly winged condition. This species is very active, running lightly and dropping from the branch at the slightest jar, and were thus seen everywhere on the ground as well as on the trunks of evergreens and other trees where they do not feed.

Ants were observed to be traveling to their nests with these aphids in their jaws, both in the late pupal and the winged

stage. As numerous ants were doing this and from many nests, the incident was of particular interest. As the aphids appeared to be squeezed and helpless, all the ants which could be caught in about 20 minutes were made to drop their aphids for examination. The aphid in each case was either dead or roughly injured and there seemed to be but one explanation—that the ants were appropriating these juicy insects for food. In view of the peaceful and often interbeneficial relations of ants and aphids in general this occurrence seems worth noting.

Aroostook Potato Insects.

The nearly continuous rains of the season made field observations unprofitable in this part of the State. A considerable mass of miscellanous data for various potato feeding insects has accumulated, but the notes for the most part should be supplemented by observations over a longer period of years, before being recorded. A single species of plant louse, *Nectarophora solanifolii*, was followed closely throughout the season and the results given in a separate bulletin. A spring search for the tarnished plant-bug, *Lygus pratensis*, present in enormous numbers last fall,* was made May 6-8, with the surprising outcome that in a particularly favorable hibernating place only one tarnished plant-bug was uncovered in several hours' careful hunting. Meanwhile 200 or 300 ground-beetles and rove-beetles were observed skirmishing the same haunts, and the following laboratory feeding experiments confirmed the suspicion that the tarnished plant-bugs seeking this shelter the previous fall, crept literally into the jaws of their natural enemies.

Predaceous Beetles and Hibernating Insects.—Feeding notes for ground-beetles and rove-beetles. A potato field near Houlton, the vines of which were in the fall of 1906 overrun with tarnished plant-bugs, 2 species of flea beetles (*E. cucumeris* and *S. hudsonias)* as well as other plant feeding insects, is bordered by tempting shelter for hibernating insects. At the left of this field separating it from the next is a lane with a line of logs laid in lieu of a fence. Grass and weeds grow the whole distance and more or less rubbish (piles of old potato vines, etc.)

* Me. Agr. Exp. Sta. Bul. 134, p. 214-215.

have been tossed up along the ridge. At the right of the field is an uncultivated piece of land, part swamp and part wooded knolls, along the slopes of which the fallen leaves are caught in drifts. Search was made in the spring, May 6-8, before their hibernating pests were on the wing in this locality, and though tarnished plant-bugs were found in considerable numbers under the leaves at the right of the field where predaceous beetles were not present to any great extent, at the left, equally favorable hibernating ground to all appearances, these insects were found in the proportion of 1 to several hundred ground-beetles and rove-beetles. The inference was acted upon by collecting the beetles for laboratory observations as to their diet. The ground-beetles were the common Carabid species, *Pterostrichus lucublandus* Say.

Test with a lot of 22 ground-beetles.

May 11. They were given one *Cosmopepla carnifex* which they did not eat until May 18.

May 13. They were given 2 negro bugs *(Corimelæna pulicaria)*. These they devoured May 15.

May 14. They were given 6 sowbugs. May 18 only one live sowbug was left and a beetle was carrying off bits of a sowbug.

They showed no eagerness in regard to any of the foregoing insects. May 18, however, they became much excited upon being given an inch-long moth pupa. They tried patiently to bite it, but the pupal skin was particularly hard and it slipped about so that it had to be finally cut for them. In less than a minute 20 of the 22 beetles were either feeding upon the pupa or fighting violently for a chance. They hauled one another off by the legs and were very much excited and vicious, the taste of this food seeming to make them tigerish. They had been stupid for a week previous. While they were still excited over the one-inch pupa they were offered a cecropia pupa taken uninjured from the cocoon. This they attacked at the abdominal creases and succeeded in biting through. After gorging at this feast the beetle abdomens protruded beyond the wing covers for more than one-sixteenth of an inch, giving them a peculiar appearance.

Test with Lot of 8 ground-beetles.

May 13. They were given 8 negro bugs *(Corimelæna pulicaria)* and one *Cosmopepla carnifex*. May 18, 3 negro bugs and the *C. carnifex* had been eaten. A crushed live negro bug offered them was devoured at once. They showed hesitation in attacking live ones. Their jaws seemed to find little purchase when they tried. Four beetles were observed to bite at the same negro bug, but their jaws slipped off every time without harm to the bug.

May 18. A sowbug which had been with them for 5 days was still alive and unharmed.

May 18. They were given an unbroken cecropia pupa, which they soon punctured at the abdominal rings and gorged as much as their bodies would hold.

Test with lot 23 ground-beetles.

May 10. They ate on this date 3 cut worms (a little less than 1 inch long), 2 tarnished plant-bugs and 1 wounded sowbug.

May 11-12. They devoured 5 unwounded sowbugs and 1 *Cosmopepla carnifex*.

May 13. They disposed of the half of a beetle *Serica vespertina* that was cut for them.

May 15. They were offered small eggs but remained indifferent to those that were broken for them as well as the whole ones.

These ground-beetles seem a little shy about attacking their prey, but when the first pair of jaws have pierced the chitinous skin the other beetles gather about and there is soon nothing left of the soft parts of the victim. If a morsel is small enough a beetle grabs it and runs, often with several beetles after him. At the body of an insect too large to be dragged much they pile up one above another devouring the prey, or if others crowd them away they bite viciously at one another for a place. They nip at one another between the thorax and abdomen or pinch each others' legs. One beetle had one of his legs bitten off between the femur and tibia by another who was trying to drag him away from a cutworm.

Test with the rove-beetles or Staphylinids.

These beetles ate tarnished plant-bugs, negro bugs (*C. pulicaria*), *Cosmopepla carnifex* and cutworms. Three Staphy-

linids ate a fourth of the same species which was enclosed in the same vial with them. They had no other food at the time. Two individuals were observed pulling at 1 small cutworm like 2 chickens over an earthworm, each bracing its legs and tugging while they curved up the tips of their abdomens high in the air with a threatening jerk. A small cutworm was given to a pair of hungry rove-beetles. The female dragged the partly devoured caterpillar beneath her and bit the male so viciously when he attempted to share it that he died about an hour later.

All the insects fed to the Staphylinids as well as the Carabids were alive and uninjured except when otherwise stated.

The fate of countless hordes of hibernating insects must be settled by such predaceous beetles during the fall and spring, and thus such lively and difficult insects to combat as the tarnished plant-bug find a natural check in the voracious appetites of these beetles everywhere to be seen skirmishing over the ground and under rubbish. The common ground-beetles would seem effective particularly with such soft-bodied insects as the tarnished plant-bug which proved attractive morsels during the feeding observations. This pest is particularly active only in the warmth and sunny weather, and seeks shelter during weather which the ground-beetles accept for hunting days. Its dormant days particularly during the fall and spring are a vulnerable season in the life history of the tarnished plant-bug at a time when the ground-beetles are still active. Such natural aids as these are, it is to be regretted, often entirely unappreciated, yet they accomplish more in a case like the tarnished plant-bug which is often not practically combatable by artificial means than man could possibly hope to do.

Cosmopepla carnifex.—July 19 about 20 of these little black and red bugs which are numerous upon potato, mullein, mint, thistle, buttercups and many other plants near Houlton were caged upon a potato plant in the insectary. August 13, one bug and several young ones were still feeding upon the plant, the stalks and leaf stems of which showed numerous black beak wounds.

Euchistus tristigma.—From June 13 to July 4, 10 of these large bugs were caged on a potato plant in the insectary. During this time several egg clusters were deposited upon the leaves

of the plant and upon the cage. The young, hatching, took at once to the potato and fed there and the old bugs spent much time with their beaks deep in the stalks drinking sap. The beak punctures caused little swollen lumps to appear about the black wound on the stalk and along the midvein of the leaves. See Figs. 36 and 37.

Podisus modestus.—A second and larger insectary colony of the foregoing bugs, *E. tristigma,* was observed to be rapidly diminishing in numbers. Examination showed that a specimen of the predaceous bug *P. modestus* had been inadvertently caged with them. This bug was placed in a glass with 8 young *E. tristigma* and was observed to stab and suck them dry. *P. modestus* is an old and well-known enemy to dangerous insects. It was observed this summer feeding upon larvæ of the potato beetle, currant worms, tent caterpillars, cabbage worms and other caterpillar pests. See Fig. 44.

Milo, July 5, the writer found a female of this species depositing eggs on balsam fir. Two neat rows of eggs were started on the underside of a needle when the bug was found, 6 eggs having been deposited, the first at the tip of the needle. The bug was suspended dorsum down with all 6 legs clasped about a single needle, the abdomen tip pointed toward the tip of the needle. The next 5 eggs were laid regularly and alternately left and right and one egg was deposited after every 2 minutes' wait, at 2.09, 2.11, 2.13, 2.15, 2.17 P. M. exactly. The bug then left the needle and the 11 eggs.

Grasshoppers were at Foxcroft and other localities thick enough to injure potato vines, particularly along the edges of the fields, the common red-legged locust, *Melanoplus femur-rubrum,* doing most of the damage.

Blister Beetles.—From Columbia Falls, August 11 a box of beetles came with the complaint that they were "very destructive on the potatoes, many times as bad as potato bugs." These were the gray blister beetles, *Macrobasis unicolor,* Kirby, which are now and then numerous enough to be very troublesome locally. A black blister beetle, *Epicauta pennsylvanica,* also fond of potatoes, is on the increase in the southern part of the State. As the larvæ of blister beetles feed largely upon grasshopper eggs, their appearance in large numbers is almost certain to follow a grasshopper increase, and in reckoning their depre-

dations on potato and certain garden vegetables their benefits as a destroyer of grasshoppers must be taken into account. An oil beetle, *Meloe angusticollis,* closely related to the blister beetles, was found here and there eating potato leaves, but these are not numerous enough to do any damage.

Trichocera regelationis Linné.—Maggots breeding in potatoes. May 17, in response to complaints of maggoty potatoes, a visit to Patten was made in order to examine the infested potatoes. Great numbers of slender maggots were found in a lot of potatoes that froze last fall and were soft and rotting in May. Some of these potatoes were placed in the insectary and the adults which emerged about June 1 proved to be the species recorded. A second generation developed in the insectary, 16 adults appearing about October 26. Whether this species would develop in healthy potatoes was not ascertained.

Gall Insects.

No attempt has been made to list the insect galls of Maine. The following few species taken in this State are in the Station collection, together with the insects emerging from them. Such of these as had not previously been determined were submitted to Mr. William Beutenmuller, American Museum of Natural History, who kindly determined them:

Aphid galls.—Pemphigus rhois, Fitch, on sumach; Pemphigus populimonilis, on Populus balsamifera; Hormaphis hamamelidis, Fitch, on Hamamelis virginiana; Hamamelistes spinosus, Shiner, on Hamamelis virginiana; Colopha ulmicola, Fitch, on elm; Chermes abietis, Linn, on spruce.

Mite galls.—Acarus serotinæ, on wild cherry; Acarid, on Amelanchier; Phytoptus (Eriophyes) quadripes, Shimer, on Norway maple.

Dipterous galls.—Cecidomyia niveipila, O. S., on oak; Cecidomyia sp., on hazel nut; Cecidomyia sp., on Cratægus; Cecidomyia batatas, O. S., on willow; Cecidomyia strobiloides, O. S., on willow; Cecidomyia rigidæ, O. S., on willow; Cecidomyia solidaginis, Loew., on golden rod.

Hymenopterous galls.—Andricus palustris, O. S.; Andricus punctatus, Bass., on oak; Andricus (Callirhytis) scitula, Bass., on oak twigs; Andricus sp., on red oak; Andricus ventricosus,

Bass., on oak; Diastrophus turgidus, Bass., on red raspberry; Diastrophus cuscutæformis, O. S., on blackberry; Biorhiza forticornis, Walsh., on Quercus alba; Eurostra solidaginis, Fitch., on golden rod; Holcaspis globulus, Fitch., on oak; Rhodites globulus, Beuten., on rose; Rhodites bicolor, Harr., on rose; Rhodites rosæ, Linn, on rose; Rhodites radicum, Bass., on sweet briar; Solenozopheria vaccinii, Ashm., on Vaccinium canadense; Andricus lanata, Gill., on red oak.

Table Recording Some of the Insect Collections of 1907.

A considerable number of insects interesting either in themselves or deriving a significance due to the circumstances in which they are found, come to the attention of the Station each season. A few of these which it seems desirable to record without extended notice are listed in the table on the 3 succeeding pages.

Table recording some of the insect collections of the season of 1907.

Scientific name.	Common name.	Date.	Locality.	Remarks.
Coleoptera.				
Adimonia cavicollis Lec	Cherry leaf beetle	July 5	Milo	Riddling leaves of wild cherry. Depositing eggs.
Adoxus vitis Fabr		July 30	Sherman	Feeding on leaves of Salix sp.
Agrilus ruficollis Fab	Red necked blackberry borer	July 11	Farmington	Adults feeding on blackberry leaves.
Amphicoma lupina Lec		July 29	Auburn	Reported very numerous in Timothy meadow.
Anthobium pothos Mannh		July 6	Orono	Numerous in blossoms of Vibirnum cassinoides L.
Brachyacantha ursina Fab		July 18	Orono	Great numbers on cherry tree in orchard.
Brachyacantha ursina Fab		July 5	Milo	Common on brake fern. Mating.
Callidium antennatum Newm	Black horned Callidium	May 27	Athens	Adults numerous in attic of new house.
Callidium antennatum var	Black horned Callidium	June 25	Orono	Resting on cedar trunks.
Clytanthus ruricola Oliv		July 8	Orono	Adult beetle feeding on rose buds.
Crepidodera helxines Linn	Small willow flea beetle	June 15	Portland	Eating willow, wild cherry and apple leaves.
Criocephalus agrestis Kirby		July 14	Orono	Adult beetle taken.
Cryptocephalus notatus Fab		June 28	Houlton	Adults feeding on hazelnut and willow. Mating.
Cryptorhynchus lapathi Linn	Willow borer	June 7	Orono	Single beetle on willow twig.
Dibolia borealis Chevr		June 18	Throughout the State	Leaves of plantain, Plantago major, everywhere riddled by this flea beetle.
Dichelonycha elongata Fabr		June 26	Orono	Feeding on leaves of alder, birch and plum.
Dichelonycha testacea Kirby		June 26	Orono	Feeding on leaves of alder, birch, and plum.
Disonycha 5-vittata Say		July 11	Orono	Common on willow. Mating and depositing eggs.
Gymnetron teter Fabr		July 18	Sherman	Numerous among buds of mullein, Verbascum thapsus L.
Haltica carinata Germ		June 26	Orono	Beetles numerous feeding on elm. Eggs yellow, in rows along midrib and other veins.
Haltica ignita Seliger	Lesser grape vine flea-beetle	June 18	Portland	Common. Eating foliage of wild rose.
Hoplia trifasciata Say		July 5	Milo	Beetles numerous in flower clusters of Viburnum cassinoides L. Mating.
Hylesinus aculeatus Say	Ash timber beetle	Sept. 6	S. Waterford	"In quantities on windows."
Isomira quadristriata Coup		July 5	Milo	Numerous in flower clusters of Vibernum cassinoides L.
Lina lapponica Linn		June 28	Houlton	Adult taken on Populus.
Malachius æneus Linn		June 28	Houlton	Flying about buttercups and other meadow flowers
Monohammus marmorator Kirby	Marbled pine borer	Aug. 12	Bar Harbor	Single specimen taken.
Pissodes dubius Rand			Orono	Common.
Phyllobrotica limbata Fabr		July 11	Farmington	Beetles riddling deadly night-shade. Numerous.

Polygraphus rufipennis Kirby	Destructive spruce bark beetle	June	28	Houlton	Near bridge over Meduxnekeag R. which was filled with logs.
Rhabdopterus picipes Oliv		July	11	Farmington	Numerous on blackberry eating leaves. (They ate both potato and apple in confinement).
Rhagium lineatum Oliv.....	Ribbed pine borer.....	June	12	Orono	Adults common.
Rhopalopus sanguinicollis Horn..	.....	June	25	Orono	Adults common.
Rhynchites cyanellus Lec	....	July	30	Sherman	On Salix sp. Mating.
Saperda calcarata Say.....	Poplar borer.....	Aug.	10	Orono	Single specimen taken.
Saperda mœsta Lec	Poplar borer.....	June	15	Veazie	23 adult beetles taken just before emerging from galls on twigs of single tree, Populus balsamifera
Sciaphilus asperatus Bonsd	.....	July	25	Farmington	Adult feeding on elder berry leaves, also taken in strawberry bed.
Serica sericea Ill.....	Silken Serica.....	June	15	Orono.....	Numerous on alder and birch.
Trichius affinis Gory	.....	July	15	Orono	Adults eating rose blossoms.
Trirhabda canadensis Kirby	....	July	24	Kennebunkport..	Numerous, eating leaves of goldenrod.
Lepidoptera.					
Ceratomia amyntor Geyer.....	Horn shouldered sphinx.....	Aug.		Various localities	Larvæ often reported from elm. Usually the green variety but sometimes the brown.
Eufitchia ribearia Fitch	Currant span worm.	July	16	Houlton	Larvæ on wild currant. Moths emerged July 31. Part of larvæ parasited.
Euproctis chrysorrhæa Linn.. ...	Brown tail moth	July	24	Kennebunkport..	Moths numerous. Depositing eggs.
Euproctis chrysorrhæa Linn.....	Brown tail moth	Aug.	14	N. Haven	2 live female moths received with the eggs masses just deposited Late specimens.
Euproctis chrysorrhæa Linn.....	Brown tail moth	Sept.	4	W. Pownal	An egg mass received, not yet hatched. Very late.
Hybernia tiliaria Harris	Lime tree winter moth.....	June	28	Houlton.....	Larvæ on apple and wild cherry.
Hyperchiria io Fabr.....	Io moth	.....		Various localities	Larvæ numerous on trees and in gardens. Several cases of painful poisoning reported.
Oxyptilus tenuidactylus Fitch	The raspberry plume	July	11	Farmington.....	Moths common resting on wild blackberry. Mating
Paonias excæcatus S. & A.....	Blind eyed sphinx	Sept.	10	Orono.....	Larva covered with cocoons of Braconid parasites. On willow.
Paonias myops S. & A.....	.....	July	18	Houlton....	A pair of moths.
Phoxopteris nubeculana Clem.....	Apple leaf sewer.....	Sept.	11	Clifton.....	Larvæ numerous in orchard.
Sesia tipuliformis Linn.....	Currant borer.....	June	29	Orono.....	Moths collected from currant bushes. Mating.
Sphinx chersis Hbn.....	Pen marked sphinx.....	.....		Various localities	Moths and larvæ very common.
Sphinx drupiferarum S. & A.....	....	.....		Various localities	Moths and larvæ very common. Many parasited by tachinids.
Sphinx gordius Cram	Apple sphinx.....	July	2	Exeter	Larva.
Tolype velleda Stoll...	Velleda lappet	.....		Various localities	Larvæ numerous during August on apple. Moths depositing eggs, Sept. 17 25.

Table recording some of the insect collections of the season of 1907 Concluded.

Scientific name.	Common name.	Date.	Locality.	Remarks.
Diptera.				
Anopheles quadrimaculatus Say..	.....	Sept. 9	Orono	Taken in house.
Phorbia brassicæ Bouché.....	Cabbage maggot.....	Apr. 30	Winthrop.....	Pupæ near roots of diseased lettuce in hot beds. Adults emerged May 13.
Phorbia cæparum Meigen	Onion maggot.....	June 29	Orono	In Onions. Adult flies emerged July 22.
Rhagoletis pomonella Walsh.....	Apple maggot	July 16	Orono	Flies common about apple trees.
Rhagoletis pomonella Walsh.....	Apple maggot.....	July 11-25	Farmington	Flies common about apple trees.
Rhagoletis tabellaria Fitch	.....	July 11-15	Orono	Flies numerous upon Cornus stolonifera Michx. Later, maggots of (probably) this species plentiful in the berries.
Hymenoptera.				
Limneria gulgnardi	.....	Sept. 14	.....	Parasites bred from red humped caterpillar, Oedemasis conclina.
Urocerus abdominalis Harris.....	Yellow banded Urocerus	Aug. 8	Houlton	Single specimen male.

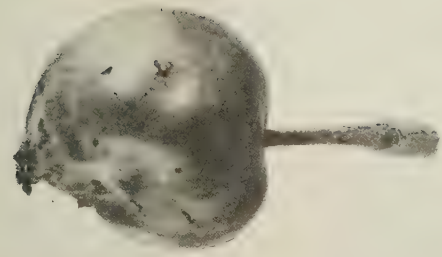


Fig. 35. Apple deformed by Plum curculio. The apple figured was taken from an orchard near Portland about the middle of July, 1907. See page 269.

Fig. 37.

Fig. 36. Eggs and recently hatched young of plant feeding bug. *Euchistus tristigma*, on potato leaf. Notice wound on stem which is caused by the full grown bug of same species shown in Fig. 37. Insectary material, Orono, 1907. See page 277.

Fig. 38. Green striped maple caterpillar, *Dryocampa rubicunda*. Taken near Greene, Me., August 14, 1907. See page 263.

Fig. 39. Fig. 40. Fig. 41. Fig. 42. Fig. 43.

Figs. 39, 40, 41, three color varieties of "The Prominent" caterpillar which ravaged hardwood growths in Maine this season. Specimens collected at South Leeds August 15, 1907.

Figs. 42, 43. Pupæ of "The Prominent" taken at Upper Gloucester, August 17, 1907. See page 263.

Fig. 44. Predaceous bug, *Podisus modestus* (slightly enlarged), which feeds upon destructive caterpillars and other insects. See pages 262 and 277.

LIST OF AVAILABLE PUBLICATIONS ON COMMON ORCHARD INSECTS.

Those published by the U. S. Department of Agriculture will be sent on application to your Congressmen, or to the Secretary of Agriculture, Washington, D. C.

Those published by the Maine Department of Agriculture can be obtained from the Commissioner of Agriculture, Augusta, Maine.

And those published by the Station may be had on application to the Maine Agricultural Experiment Station, Orono, Maine.

Antique tussock moth Δ
Aphides affecting the apple +
Apple maggott or Railroad worm Δ
Brown-tail moth Δ 0 X
Canker worm Δ
Cecropia moth Δ
Cherry tree tortrix Δ
Codling moth 0
Fall web worm Δ
Flat headed borer +
Forest tent caterpillar Δ
Gypsy moth Δ 0 X
Hickory tiger moth Δ
Io moth Δ
Oyster shell bark scale Δ
Pear slug +
Plum curculio +
Red-humped caterpillar Δ
Rose chafer +
Round headed borer +
San Jose scale +
Sphinx moths Δ
Spotted tiger moth Δ
Tent caterpillar Δ
Tiger swallow-tail butterfly Δ
White marked tussock moth Δ
Woolly aphis of the apple +
Yellow necked caterpillar Δ

Δ Me. Agr. Exp. Sta. Circ.
+ U. S. Dept. of Agric., Bureau of Entomology Circular.
0 U. S. Dept. of Agric., Farmers' Bulletin.
X Maine Dept. of Agriculture, Augusta.

Crocigrapha normani Grote.

By Edith M. Patch, Orono, Maine.

(Plate XIII)

A mass of lepidopterous eggs flatly attached to a leaf of wild cherry was collected near Orono, June 12, 1907. These hatched June 14th and were fed from that time upon apple in the insectary. As the larvæ, noctuids of no very distinctive features, did not answer the description of any known to feed upon wild cherry or apple, they were bred in order to establish their identity. By July 15th about half of the lot had pupated, the others pupating from seven to ten days later.

As to their feeding habits it may be said that they remained day and night upon the branches of apple with which their cage was kept supplied, and they fed greedily upon both the leaves and the green apples which they ate to the core. They were easily disturbed, however, and would then commonly drop to the floor of the cage. They took long periods of rest during the day and particularly when nearly grown did their most vigorous feeding at night, though they lunched also by daylight.

Pupation took place in the earth which was provided in their cage. Although the larvæ were all from one brood and they hatched at the same date, their growth was not uniform in spite of the fact that they were kept under precisely the same conditions, and the last of the pupae were formed more than two weeks after the first.

One moth emerged in the laboratory in May, 1908, and this was identified by Dr. Harrison G. Dyar as *Crocigrapha normani*, Grote. Several other pupae were alive at this time, but in an attempt to hasten their emerging they were overheated and killed.

As nothing whatever is recorded of the life-history of this moth, the following description of the larva is taken from my notes at the Maine Agricultural Experiment Station:

June 29, 1907. Larva half grown. Head clear amber in color with two glistening black spots on each lobe. Ventral and ventro-lateral body and pro-legs pale greyish blue-green. Seven very delicate longitudinal lines of pale blue extend along the body, one being mid-dorsal and the three on each side placed (a) one dorsal the spiracle line, (b) one half way between the mid-dorsal line, and (a), and (c) one ventrad the spiracle line. Between the mid-dorsal line and (b) the body is soft green with a bluish cast. Between (a) and (b) extends a dark green stripe.

July 9, 1907. Larva 1½ inches long, and apparently about full grown. Head shiny yellow with one irregular dark mottled blotch on each lobe. Dorsal and dorso-lateral aspects mottled gray-brown. Ventral and ventro-lateral (to above the spiracle line) pale gray green. Legs pale.

The accompanying photograph (Plate XIII.) taken July 10, 1907, gives a good idea of the form of this larva and is also suggestive of its feeding habits.

The pupa, which is glistening brown, varies from 15 mm. to 19 mm. in length.

Types of the larvae and pupae are deposited in U. S. National Museum and in the collection of the Maine Agricultural Experiment Station.

CROCIGRAPHA NORMANI GROTE.

IMP. BUREAU, EN
REC'D 19 APR. 1913
ANS'D 484

Pemphigus tessellata: Alternate Host, Migrants and True Sexes.*

By Edith M. Patch.

(Plate XXIV)

Ever since Fitch recorded in his brief, original description in 1851 "I have searched in vain for winged individuals of this species," the alder blight has been from time to time an object of speculative interest to aphid observers, although if any real attempt has been made to trace the flight of the migrants and locate the winter eggs it has been heretofore unrecorded.

With a species so conspicuous and of such wide distribution, the absence of a knowledge of its different stages for the half century or more since it was described would seem strange were it not that the species certainly gives as defiant a dare to the life history detective as a *Pemphigus* can and that is saying a good deal.

To begin with there seems to be no place in the apparently closed cycle of alder blight for an alternate host and winter eggs. According to the observations of the writer for the past five years, apterous viviparous forms of *Pemphigus tessellata* are present on the alder branches (*Alnus incana*) from about April 20th to late October, weather permitting, and the rest of the year hibernating as young apterous viviparous forms in clusters or singly among the fallen leaves at the base of the alder. The return of these hibernating young to the alder branches in the spring completes an apparent cycle for a single host plant and certainly suggests no need for variety in diet. It was not then with any thought of an alternate host that these observations were begun for this species in Maine but with the hope of finding at some time during the year a sexual generation upon the alder. Protected under the flocculent mass secreted by this *Pemphigus* the presence of a winged generation is not revealed (unless special collection and search for forms with wing pads is made) until the form is mature. From late August until the middle of September at the same time the

*Papers from the Maine Agricultural Experiment Station: Entomology, 30.

last apterous viviparous generation is maturing and bringing forth an excessively numerous progeny which winter among the leaves on the ground, a generation of large winged forms appears upon the alder stem in flocculent masses containing sometimes a few apterous forms and sometimes in clusters where the apterous forms are the more numerous.

These winged forms take flight without producing young upon the alder, and early in September in those seasons when the species is particularly numerous the flight of this *Pemphigus* is so considerable as to give the appearance of a slight snow storm in the air. The bodies of the migrants are dark but the wings are whitish and powdered and much of the flocculent wax is retained upon the abdomen even in flight.

One such flight was noticed September 1, 1905 and several in late August and early September, 1908. On account of the excessive numbers of syrphus maggots and the larvae of the wanderer butterfly, *Feniseca tarquinius** in 1906 the alder blight was nearly exterminated in the vicinity of Orono that season and during 1907 the colonies were not plentiful. This present season, however, they are again numerous and at the time of their flight a winged *Pemphigus* was seen to be congregating in conspicuous numbers upon the trunks of maple on the campus, particularly *Acer dasycarpum* Ehrh. and the ornamental cut leaved maples. Microscopic examination showed no distinction between the Pemphigus newly alighting upon the maple trunks and these taking flight from the alder and it was with intense interest that the following observations were made.

August 27, 1908. Winged viviparous *Pemphigus* covering the trunk of cut leaved maple. They are seeking the crevices and rough places in the bark and are making no attempt to feed.

August 28. Pieces of bark torn back from maple trunk show the winged viviparous *Pemphigus* and their numerous progeny, minute forms which under a lens prove to be the sexual forms, many of them being in copulation.

August 28. Winged *Pemphigus tessellata* removed from alder before flight and placed in cage upon twigs of maple

* Me. Agr. Exp. Sta., Bul. No. 134, pp. 216-217.

in laboratory. They settled contentedly upon the twigs. August 30. The progeny of winged *P. tessellata* placed on the maple twigs in laboratory are sexual forms proving upon microscopic examination to be exactly like those collected from under bark of maple on campus.

September 3. Numerous yellow eggs are present under bark among the *Pemphigus* on maple trunks on the campus.

September 4. *Pemphigus tessellata* numerous on wing and observed floating in the air on campus. Individuals were watched and seen to alight on the maple bark where they settled and sought rough places in the bark.

* * * * * * * * * * *

We have, then, unquestionably the oviparous females and males of *Pemphigus tessellata* deposited upon maple trunks by the winged migrants from the alder and the eggs of this species deposited under the bark of the maple. Coupled with the fact that *P. tesellata* hibernates also in the young apterous viviparous form among the leaves at the base of the alder clumps this would seem rather to complicate matters than to prove a missing link.

On the basis of these observations it seems safe to hazard the following guess as a working hypothesis. *Pemphigus acerifolii* Riley, a flocculent species on maple leaves is very common from spring until mid July. A winged generation then appears and disappears. *Pemphigus acerifolii* has been known only upon the maple leaf,—the rest of the cycle never having been recorded. With this in my mind my aphid notes were searched for these two species with the following suggestive coincidence:

"No. 19-05. *Pemphigus acerifolii* Riley, Orono. July 15, 1905. Winged forms present in great numbers on leaves of maple along river. Ready for migratory flight."

"No. 30-05. *Pemphigus tessellata.* Orono. July 18, 1905. Single viviparous winged forms scattered about on the alder leaves (mostly on under side), followed by a group of young apterous viviparous forms present on the alder branches in great numbers, producing young."

The foregoing record of viviparous *winged* forms on the alder leaves at the time it was taken seemed puzzling, as no

pupae, or individuals with wing pads, could be found on the alder tree; but in the light of this fall's observations there seems little reason to doubt that these sporadic winged forms on the leaves of the alder are the return migrants from the maple, and that *Pemphigus acerifolii* Riley is merely the maple name for *Pemphigus tessellata* Fitch, the stem mother of which migrates from the bark to the leaf upon hatching in the spring.

In accordance with my custom for five years, specimens of aphids have been saved, for every record made, either in balsam mounts or as alcoholic material, so that they are ready for reference at any time. During the winter of 1905-06 I made a careful comparison of all the winged species of *Pemphigus* taken in Maine up to that time, and was particularly struck by the fact that mounted specimens of *P. tessellata* and *P. acerifolii* were indistinguishable and made the grumbling comment "If these are two species there is no structural basis for systematic work with Pemphiginae." However, there seemed no place in the *tessellata* cycle for *acerifolii*, several attempts to colonize maple with apterous forms of *tessellata* were entirely unsuccessful and for the next two falls the species was so scarce that the migrants were not much in evidence, and no clue was forthcoming until this fall.

The life cycle of the alder blight is by no means solved by the location of the sexual generation. The true association of *P. tessellata* and *acerifolii* yet remains to be established upon the alder. With the clues now at hand these species (two or one) can unquestionably be traced in time. The abundance of alder and maple at Orono and the usual presence in great numbers of *P. tessellata* and *acerifolii* make it an ideal situation for work with these forms and favor my plans for thorough study of the *Pemphigus* upon the alder and maple.

There is no need of crowding with further details from notes now at hand this preliminary paper, the object of which is merely to place the sexual forms of *P. tessellata* for which the following brief description will suffice.

Oviparous female.—A pale yellowish form, apterous and non-rostrated, measuring 1.33 mm. in length. Antennae of

PATCH ON PEMPHIGUS TESSELLATA.

Showing masses of alder blight, containing both mature and apterous viviparous forms and migrants already winged and ready for flight.

four segments. Two eyes with three separate dark globular pigmented masses. Abdomen ovoid. Deposited by viviparous migrant from alder, in crevices of bark on trunk of maple. Shortly after birth this form sheds a thin white membranous skin which commonly adheres to caudal tip of abdomen. After copulation the female deposits a single large egg.

Male.—Darker than female and greenish. Apterous and non-rostrated, measuring .68 mm. in length. Antennae of four segments. Two eyes with pigmented area in one large irregular mass. Abdomen linear. Sheds skin after birth as does the female. This form is smaller than the egg it fertilizes.

Egg.—Comparatively large egg filling most of the abdomen of the female and measuring about .83 mm. It is yellow and glistening and deposited usually with a downy white secretion.

BULLETIN No. 161.

THE SADDLED PROMINENT,

Heterocampa guttivitta (Walker).*

EDITH M. PATCH.

The present bulletin deals with a caterpillar outbreak so remarkable that the writer from sheer interest in it put aside other work so far as possible in order to keep in touch with the situation. Although a native insect the species under consideration has but occasionally been met with in the State, and prior to 1907 in numbers so slight that it had not seemed worth any special attention. The specimens of these caterpillars in the Station collection had not been determined except as to genus, never more than 3 or 4 inquiries had come concerning it during any one season and then it was reported only as scattered individuals found on apple trees.

ACKNOWLEDGMENTS.

During 1907 and 1908 numerous items have been sent in from people all through the infested areas which has added to the interest of the investigation. Some of the aid which has been given in this matter is herewith acknowledged in appreciation by the Station. Mr. Allen H. Jordan of Upper Gloucester has furnished pupæ for much of the parasite breeding and has for two seasons acted as guide into infested forest growth with which he is familiar. Mr. Fred R. Jones of Mercer aided materially with the investigation in that part of the State. To Mr. Dayton Edwards is due most of the molting records and the information concerning the conditions at Upper Gloucester, Sebago Lake and North Fryeburg, July 11-July 17. The bird observations were made by Mr. William C. Woods who also aided in the collection of parasites. Mr. Perley Skofield's assistance made much of the insectary work possible.

---

* Papers from the Maine Agricultural Experiment Station: Entomology No. 31.

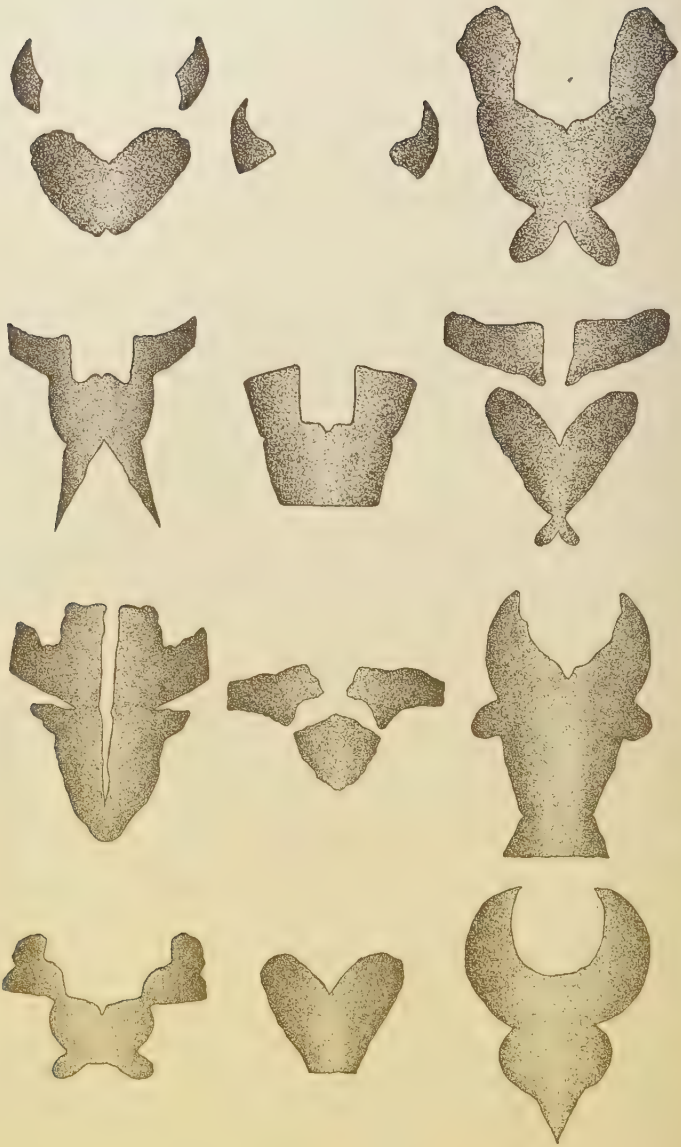


FIG. 14 Saddle marks of saddled prominents in third, fourth and fifth instars, showing a few of the innumerable patterns of this dorsal design. Drawn by Mr. R. L. Hammond.

Discussion of Name "Saddled Prominent."

Since Walker named the species in 1855, *Heterocampa guttivitta* has not attracted enough attention to have been given a common name. It has not, to be sure, lacked variety in classical designations, having been discussed under at least five generic and seven (partly by error) specific names.*

The thoroughgoing attack which it has made on hardwood forests from New York to Maine the past two seasons, however, brings it conspicuously before the public and the lack of a common name is an inconvenience. This inconvenience was met tentatively this season both by the Maine Experiment Station and the Maine Department of Agriculture by the designation "beech prominent," a name very naturally suggested by the noticeable preference of this insect for the beech for the past two seasons in Maine. There is, however, an obvious objection to dubbing a more or less general feeder with the name of its favorite plant, and "beech prominent" did not for this reason seem desirable.

"Antlered maple caterpillar" ** has been suggested, but for

---

* *Heterocampa guttivitta* (Walker).

Cecrita guttivitta Walk., Cat. Lep. Het. Brit. Mus., v. p. 992, 1855. *Drymonia mucorea* Herr.-Schaeffer. Samml. aussereur. Schmett., fig. 514, 1856. *Lochmæus cinereus* Pack., Proc. Ent. Soc. Phil., iii, p. 372, 1864. *Misogada sobria* Walk., Cat. Lep. Br. Mus., xxxii, p. 450, 1865. *Heterocampa doubledayi* Scudder, in Harris Ent. Corresp., p. 134, 1867. French, Can. Ent., xii, p. 83, 1880. Sixth Ann. Rep. S. Ill. Normal Univ., p. 651, 1880. Packard, Bull 7, U. S. Ent. Comm. Ins. Inj. Forest Trees, p. 40, 1881 (Quotes French's description). *H. guttivitta* Grote, New Check List N. Amer. Moths, p. 19, 1882. *H. pulverea* Pack., Fifth Rep. U. S. Ent. Comm., p. 159, p. 397, 1890. *Lochmaeus olivatus* Pack., Fifth Rep. U. S. Ent. Comm., p. 39, 1890. *H. pulverea,* Proc. Bost. Soc. Nat. Hist., xxiv, p. 548, 1890 (*H. pulverea by error*). *H. guittivitta* Dyar, Psyche, vi, p. 178, 1891. (Fourth and last larval stages; cocoon and pupa). *H. guttivitta* Smith, List. Lep. Bor. Amer., p. 31, 1891. Kirby, Syn. Cat. Lep. Het., i, p. 564, 1892. *Cecrita guttivitta* Neum. and Dyar, Trans. Amer. Ent. Soc., xxi, p. 207, 1894; Journ. N. Y. Ent. Soc., ii, p. 117, Sept., 1894. *H. guttivitta* Packard. Mem. Nat. Acad. Sci., VII, pp. 230-235. Plates. 1896. *H. guttivitta* Beutenmüller, Bombycine Moths of Vicinity of New York City. Bul. Amer. Mus. Nat. Hist., X, p. 425, 1898. *H. guttivitta Lugger,* Univ. of Minn. Agric. Exp. Sta. Bul. 61. p. 171 (quotes Beutenmüller's description) 1898.

** Dr. E. P. Felt, Journal of Economic Entomology, Vol. 1, No. 2, p. 150. (Also N. Y. State Ent. 23 Rep't pp 21-23 which appeared while this present bulletin was in press).

this outbreak in Maine, at least, the species has shown a decided preference for beech. The antlers (See Figure 16) are lost after the first few day of its life when it is very tiny so that this would not seem a fortunate popular name for a caterpillar which comparatively few people would even see until the antlers had been shed. Then too, other closely allied species bear antlers as young larvæ, and *Heterocampa biundata,* which retains them through three stages, feeds also upon maple.*

The "purple marked forest caterpillar" ** would seem more descriptive of the older caterpillars, though the dark markings on this species in Maine while exceedingly variable were more uniformly reddish brown than purple. The careful larval descriptions of Doctor Packard * and Doctor Dyar *** indicate that purple marked caterpillars were also the exception among those examined by them, the former not mentioning purple and the latter describing it in that color for "a peculiar variety of guttivitta." It is very difficult, however, to strike upon a stable name for a variable species and except for the length of "the purple marked forest caterpillar" this name might be a convenient designation.

The family *Notodontidae* to which the species in question belongs has been popularly named "The Prominents."

"In some species the front wing has a prominence or backward projecting lobe on the inner margin, which has suggested the common name of Prominents for these insects. The name is more generally appropriate, however, for the larvæ, as a much larger proportion of them than of the adults bear striking prominences." ****

We have among related species popular names based upon larval characteristics as "unicorn prominent," "long-horned prominent;" and "saddled prominent," seeming appropriate and convenient enough a name, has been settled upon mutually by the Maine Experiment Station and by the Maine Department of Agriculture, in order that it may bear but one popular appellation in this State.

---

* Packard. Bombycine Moths.

** E. D. Sanderson, Newspaper circular. August 1908.

*** Psyche VI, p. 178, 1891.

**** J. H. Comstock, Manual for the Study of Insects, p. 263.

The term "saddled" is suggested by the position of the most conspicuous of the dorsal markings. In different designs this saddle mark appears near the end of the second larval stage and persists through the third, fourth, and fifth stages, that is, it is present from the time the caterpillars are 8 or 9 days old until they are full fed. The saddle mark occurs on the mid dorsal portion of the third abdominal segment, and extends in most cases over the fourth and on to the fifth. Like all the markings in this species the saddle mark is subject to great variation and is sometimes exceedingly faintly traced or absent in the fifth instar. The saddle designs which accompany this discussion are drawn from specimens in the third, fourth, and fifth instars and represent only a few of the countless variations.

We have among the slug caterpillars the "saddle back caterpillar," *Sibine stimulea* Clem., but with the family name *Prominent* retained there is certainly no danger of a confusion between the names of these two exceedingly dissimilar species.

The Present Outbreak.

About the middle of August, 1907, the Station mail was flooded with complaints of this caterpillar which had made startling inroads in certain localities.* Two of these localities were visited immediately,—a large maple grove at South Leeds and approximately 100 acres of beech growth at Upper Gloucester being found at that time defoliated. The full fed caterpillars were observed to be vigorous and forming apparently healthy pupæ, so that a more serious attack was feared for the present season. With this in view the last of May, 1908, the writer made an initial trip into regions known to be infested the previous August, and frequent trips for observation were taken to certain of these localities from southwestern part of Oxford county to the southern part of Piscataquis county, during the entire caterpillar season. Insectary observations have also been made on this species through the entire life cycle.

While for the most part only enough attention could be paid to this species to accumulate a miscellany of observations, the work has resulted in some definite data not previously known for this species. The fact that for Maine only one brood occurs, the unbroken series of molting records for the same lot of cater-

* Me. Agr. Exp. Sta. Bul. No. 148. Insect Notes for 1907.

pillars, and the notes on parasites, the description of the egg, and several other observations in regard to the life cycle, seasonal history, and habits have not been previously published. In fact from an economic standpoint this species has never demanded consideration * before this present outbreak and except for careful descriptions very little attention has been given it. It is included in Packard's Forest Insects in two places (in both incorrectly determined). This season, however, the attack has occurred seriously in Vermont, New Hampshire, and New York, at least, besides this State; and doubtless much data of interest will come to light over so extended an area.

Description of the Saddled Prominent.

The descriptions which follow are made entirely from specimens bred in Maine during this present outbreak. They are, however, written with reference to the descriptions of Doctor Packard whose diction is used wherever convenient.

Moth, female. Ground color olive-greenish ashen with cream white patches and black markings. Fore wings with a marginal black line broken at the veins by a pale dot. The marginal fringe is ashen with darker lines extending from the region of the veins giving the wings a border of shallow scallops. There is a submarginal series of 6 to 8 dark spots. Discal mark a curved dark line inclosed in a lunate pale space. In some specimens this pale space extends beyond the median dark zigzag line far enough to enclose the row of submarginal dots. The body is 20 mm. long and the wings expand 40-52 mm. Figure 24 gives the female actual size and presents a better general idea of the markings than a detailed description.

Moth, male. Ground color of both wings darker than with the female, and the markings are less distinctive. Figure 23 was photographed from a particularly dark individual. The body is 20 mm. long and the wings expand 40-45 mm.

Both sexes are variable in markings.

---

* *H. guttivitta* was included in a list of 356 apple insects by Lintner (N. Y. State Ent. 11th Rep't, p 265) and an interesting portion of his introductory statement seems, in light of this present outbreak, to sound a note of prophecy:—"It is hardly necessary to state that not all the species herein recorded are to be regarded as specially injurious to the apple tree and its fruit but as each one is known to make it, at times, its food plant from choice (many others will feed upon it in confinement) the least harmful among them may at any time, through such sudden and inexplicable multiplication as is often witnessed in the insect world, become a serious pest."

Fig. 15. The Saddled Prominent.

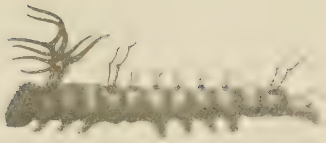


Fig. 16. First Instar.

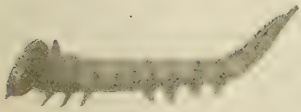


Fig. 17. Second Instar.

Fig. 18. End of Second Instar.

Fig. 19. Third Instar.

Fig. 20. Fourth Instar.

Fig. 21. End of Fourth Instar.

Fig. 22. Fifth Instar.

Larval stages of saddled prominent. After Bridgham. From Plate XXXI Bombycine Moths A. S. Packard. Memoirs of the National Academy of Sciences. Actual size indicated by lines under figures.

Egg. Pale pellucid green, the color of the ribs of the beech leaf. It is circular in outline with a diameter of 1.19 mm. The surface which is applied to the leaf is flat and the exposed surface is an unsculptured convex. The eggs are deposited singly and adhere firmly to the leaf.

Larva. In this stage the insect defies description particularly in the last instars as the dorsal pattern is exceedingly variable. In the first instar the species is characterized by 9 pairs of horns. In the latter instars the caterpillars may be in general described as green with dorsal longitudinal lines of various colors variously interspaced with designs of various shapes and colors. Such a description would at least convey an idea of the most striking characteristic of these larvae,—their high degree of variation as to markings. The most nearly constant of these is a reddish brown spot on the back of the caterpillar. This, the writer has designated as the saddle mark from its position and in some cases its form. The saddle designs figured in the bulletin were drawn from the specimens reared or collected during the summer of 1908, and give a suggestion of the variation of this mark no one of which seems to be exactly like any other. Those caterpillars which cannot find an original design for their saddle evade the responsibility by appearing with no saddle at all. Following is a description which will perhaps serve the present purpose. The form is illustrated by the accompanying figures and the size indicated by the hair line under them.

Larva. First Instar. Figure 16. Body and abdominal legs dull dark red,—head darker red. True legs black. 9 pairs of black horns occur along the mid dorsal line, each situated on a black enameled spot. The first pair just back of the head are much the largest and branched so that they have the appearance of antlers. There are no horns on the second and third thoracic segments or the seventh abdominal segment. The caudal end of the abdomen is held in an elevated position.

Larva. Second Instar. Figures 17 and 18. Body and head dark rose pink. The dorsal horns of the first instar have disappeared and are represented merely by two straight pointed projections on the first thoracic segment and by a pair of very minute points on the first, second, third, fourth, fifth, sixth and eighth abdominal segments. These minute points are black and are situated on a greenish brown mid dorsal spot.

Larva. Third Instar. Figure 19. Body green marked with bright reddish brown, except for slight tubercles representing the prothoracic horns. The body is smooth. The head is conspicuously large at the beginning of the instar with a broad pale reddish band on each side.

Larva. Fourth Instar. Figures 20 and 21. Body green with dorsal reddish brown markings varied. Head large with broad lateral band composed of 4 stripes colored black, white, pink, and yellow.

Larva. Fifth and last Instar. Figure 22. Body usually beech leaf green with a bluish cast though some are brownish and some vary from straw to almost lemon yellow and others from lavendar to deeper purple. (These were insectary caterpillars which had not been exposed to the direct rays of the sun.) The dorsal pattern was not exactly alike in any two of the caterpillars bred, varying from a pale design in whitish yellow

in some individuals to a heavy marking in reddish brown or purple in other individuals of the same age. Usually the third thoracic segment bears a dark oblique lateral mark with the ventral end slanting cephalad and the sixth abdominal segment bears a similar mark with a ventral slant caudad. Both these marks are sometimes missing and very often other similar marks are present on other segments.

This species would be a fascinating subject for a study in variation but nothing could really be done with it without the constant service of both a photographer and an artist to reproduce the intricate designs in color as no description could serve to fix them adequately.

Cocoon. Figure 26. The cocoon is formed by a very thin layer of silk usually lining a place hollowed in the leaf mold at the base of the infested tree. Sometimes the cocoon is firm enough so that it can be removed with the particles of earth attached as with the specimen photographed.

Pupa. Figure 25. Within the cocoon is a dark glistening brown pupa about 19 mm. long. Just caudad of the mesoscutum is a curve of 8 dull unpolished tubercles the two at the ends being triangular, and the other six being nearly square. The terminal spines of the cremaster are somewhat boot shaped,—the toe being turned laterad and the heel mesad.

Seasonal History.

Packard records the following dates for this species.*

"The eggs were found at Brunswick, Maine, as early as July 3, and it hatched July 11 or 12. Other larvæ, as observed in Maine, hatched about the 8th to 10th of July, feeding on the under side of the leaf, at first eating away a little irregular patch. Stage I lasts 9 days, Stage II probably 4 or 5 days. The last stage is reached a month later, August 9-10; one belated individual occurred on the oak at Providence as late as September 20 to 24.

Riley notes larvæ as occurring in July, and captures of the moths in May, June, July and August."

Doctor Dyar gives the species as "occasionally double brooded" ** and Mr. Beutenmüller says the species "is not common and possibly double brooded." ***

In view of these records the calendar for *H. guttivitta* during the past season's outbreak in Maine is of particular interest.

May 27, 1908, the writer visited a beech growth at North Fryeburg, Maine, which had been stripped by *H. guttivitta* the

* Bombycine Moths, page 234.

** Psyche VI, p. 179, 1891.

*** Bombycine Moths of Vicinity of New York, p. 426.

Male. Female.

Fig. 23. Male. Fig. 24. Female.

Moths of saddled prominent which emerged May 29, 1908. See page 325.

Fig. 25. Pupa. Fig. 26. Cocoon.

See page 322.

Fig. 27. Characteristic posture of larva resting on molting mat on beech leaf. The head molt has already taken place. Change from fourth to fifth instar. See page 328.

previous season to secure pupæ and was surprised to find the moths already emerging in great numbers in the woods. Several hours were spent collecting pupæ, an easy matter in this thickly infested region. Many moths emerged on the way to Orono but enough pupæ were secured for ample material for the life history cycle.

May 29. Moths deposited eggs upon the beech leaves with which their cages were supplied.

June 7. First instar. Larvæ began hatching and in great numbers.

June 11-12. Beginning of second instar. The larvæ spinning their molting mats on the cage and leaves June 11 and molting during the night.

June 16-17. Beginning of third instar. The mats being formed June 16, and the molt occurring during the night and June 17.

June 23-24. Beginning of fourth instar.

June 30-July 2. Beginning of fifth instar. Last stage.

July 13. The first larvæ observed to be forming pupal cells in the earth provided for them. These pupated promptly.

October 7 the date on which this bulletin goes to press, no moths have emerged from these pupæ though the pupæ are alive as evidenced by their vigorous movements on being disturbed. The pupæ were kept in the insectary under leaf mold where the temperature does not vary appreciably from that out of doors.

This record should settle the question of a double brood for Maine. If moths emerging so early as May with the succeeding larvæ full fed in mid July do not give two generations (and the summer was particularly warm and dry) there would seem to be no possible chance for two broods in this latitude.

That this species is very susceptible to temperature control is evidenced by the fact last winter that from pupæ which were wet and warmed in the laboratory moths emerged December 3, 1907.*

Individuals hibernating in a place which did not warm up early in the spring might easily be a month or so later in emerging which would give late larvæ and conversely exceedingly early individuals to emerge in the spring might perhaps make

* Me. Agr. Exp. Sta. Bul. No. 148, 1907.

possible the cycle to the moth stage the same season. Thus farther south two broods may occur.

Weather conditions may account in part for the fact that in 1908 this species was pupating about the time of month that Packard records newly hatching caterpillars,—mid July; or for the larvæ of the first instar at Upper Gloucester this season on July 11.

The insectary observations were made with ample material. There were 175 female moths which emerged in captivity. A very conservative estimate of caterpillars hatching from the eggs these deposited would be 8,000 or 9,000. (See page 331) No count of the caterpillars in the first instar was made and most of them were destroyed at that time after retaining several hundred for the breeding observations. They were healthy in captivity and an easy species to rear. They were fed entirely upon beech. The foregoing record is for the earliest of the larvæ, a group of about 50 of the first hatching being caged together for detailed data as to molting. For the later larvæ, molting records were not kept.

Pupæ collected at Upper Gloucester, June 1, 1908, and sent promptly to the Station, emerged to a great extent on the way. The last of May to early June seemed a fairly uniform date for the greatest number of emerging moths this season.

As a check upon the insectary data a tour of largely infested areas was made as follows:

July 11 at Upper Gloucester specimens from the first to the fourth instar were found but the majority of them were in the third. They appeared in general smaller than were those reared in the insectary at the same stages,—a fact possibly explained by the food supply which was abundantly furnished to the captive caterpillars while those at liberty at Upper Gloucester had comparatively stripped the beech over 100 acres or more and were in many cases starving to death.

July 15. A devastated area of approximately 150 acres of maple and beech was visited at North Fryeburg where the caterpillars were observed to be a little older than at Upper Gloucester.

July 23. Upper Gloucester was visited again. Where caterpillars had been thick 12 days before very few were now to be seen. In some places they were traveling up and down the trunks

of stripped trees and it was in such places that the predaceous Podisus (see Fig. 37) was seen to be busy stabbing the larvæ and the pile of dead and half sucked caterpillars at the bases of trees where these bugs were at work gave good evidence of their appetites. Some larvæ were dying evidently from exhaustion and starvation after traveling up and down many trees and finding no food. Nearer the outskirts of the devastated area the caterpillars were faring better as they got off into fresh growth and were feeding vigorously. Those which were observed were in their fifth (last) instar.

July 24. Sebago Lake, Cape Raymond. The caterpillars were in their fifth instar, healthy and feeding.

July 27. Norridgewock. Caterpillars in the fifth instar, some feeding and some pupating, for the most part healthy.

July 28. Mercer. Pupated in some localities. In others caterpillars in the fifth instar feeding, a few beginning to die. (See a contagious fungus disease p. 344).

July 31-August 1. Norridgewock. Some healthy caterpillars feeding; many sick and dying.

August 3-4. Mercer. Dead caterpillars present by thousands and only a few live ones seen in two days.

Aug. 5-7. Norridgewock. Collection of pupæ which were in certain localities numerous.

August 8. Sebago Lake. *Heterocampa guttivitta* had already pupated in apparently healthy shape. Other species of larvæ which were about at the time were fungus attacked.

August 10. East Sangerville. Caterpillars still feeding, though many were full fed in this locality July 26.

August 14. Buckfield. Larvæ still feeding.

SEASONAL HISTORY SUMMARY.

For Maine the saddled prominent has but one brood. The moths in 1908 emerged in greatest numbers late in May and early in June. Oviposition begins soon after mating which occurs the first night after emergence.—The eggs hatch in about 9 days and the larvæ become full grown in 5 weeks (or more according to weather conditions and food supply). During this time they molt four times. The full grown larvæ enter the ground for pupation. In Maine this season pupation took place from mid July to late August, the majority of larvæ burying

late in July. They pass the winter in the pupal stage, under the leaf mold and the moths emerge in the spring.

Habits.

The eggs are deposited singly by the female which in captivity applied the eggs to both sides of the leaf. From the reason that during both years over the whole range of the infestation the *tops* of the trees were stripped first and then the lower branches it is to be concluded that the moths by preference deposit the eggs upon the upper leaves. Perhaps the same tendency to fly high may account in part for the fact that the hillside forests were in general more largely attacked than the lowlands, which was noticeable throughout the infested districts.

An interesting feature was noticed in the feeding habits of the larvæ. The young caterpillars just hatched fed, as do the young of many species, from the surface of the leaf skeletonizing it in spots by nibbling out the parenchyma and leaving even the finest veins untouched. (See Figure 28). This habit was continued through the first instar but after the first molt the caterpillars migrated to the margin of the leaf and the meals during the second instar were obtained by eating down between the veins as indicated by Figure 29. In the third instar the feeding habits of the caterpillars is represented by Figure 30. After that Figures 31 and 32 are significant illustrations.

The saddled prominents do not cling tightly to the leaf or branch. Even in the first instar the caudal portion of the body is elevated,—the species from the first observing that characteristic family trait. A slight jar will dislodge the caterpillars from their hold and bring them rattling to the ground. (See also Combatative Measures page 349). They then climb the trunk and go to work again.

Before each of the four molts they carefully spin a thin, broad resting mat where they cling during the molt. At such times the larva usually waits with the head curved to one side as shown in Figure 27 where it will be noticed that the head molt has just occurred.

The full grown larva drops or climbs to the ground and constructs a cell in the earth or under the leaves at a distance of one to 3 inches below the surface. This cell is oval and is lined

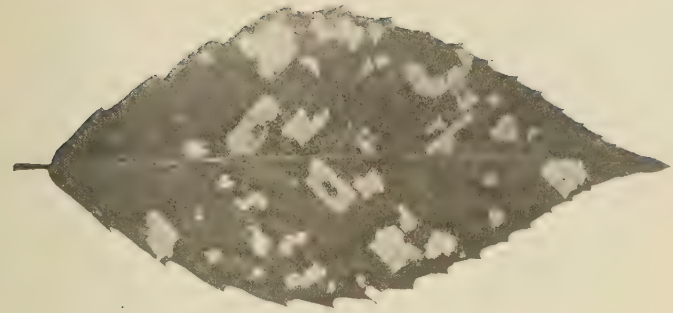


FIG. 28.

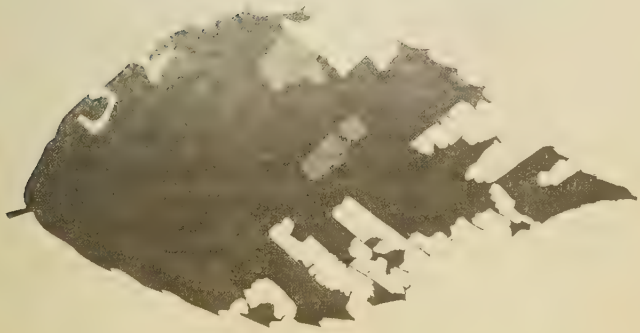


FIG. 29.

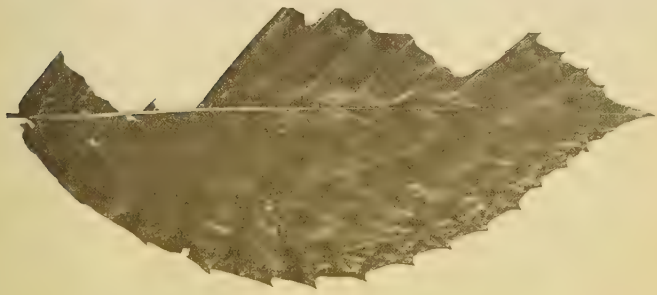


FIG. 30.

Beach leaves showing work of saddled prominent in first, second and third instar respectively. Reduced. See page 328.

by a thin spinning of silk. The structure is hardly worthy the name cocoon as it is easily broken in throwing back the leaves and the loose pupæ exposed. Sometimes, however, a fairly stable cocoon is constructed and such a one to which particles of earth have adhered is shown in Figure 26.

The insect after remaining in the pupal stage all winter emerges with the warm spring days. On May 27 the writer observed great numbers of these moths breaking through the leaf mold during the warm afternoon and creeping up some convenient object while their wings expanded.

During captivity the moths mated the first night and began laying eggs soon afterward. The length of life of an individual moth could not be estimated as the captive moths break their wings and otherwise disable themselves usually before all their eggs are deposited. As to the number of eggs laid by a single moth the following record is of interest. June 3, 1908, one female freshly emerged was dissected and the eggs in the ovarian tubes were counted. They varied from 55 to 75 in the different tubes of which there are 8, and the total number for this one moth was approximately 500 eggs. Later 12 females that had died in the cage were dissected and the unlaid eggs remaining in the egg strings were counted. The total number of unlaid eggs was 629 giving an average of 52+ of unlaid eggs to each moth. In some individuals only 5 or 6 eggs remained. In 3 individuals the number of unlaid eggs was between 125-150, however, a condition doubtless due to the moths beating themselves to death before they finish depositing eggs, in their attempts to get out of the cage.

Food Plants.

Beech leaves have been unquestionably the favorite food of this species during the two years attack in Maine. Over about 800 acres on Frye's Island, Sebago Lake, and about 800 acres on Cape Raymond, the beech was completely stripped, the birch being taken later. At Upper Gloucester the beeches were taken first these trees being defoliated over 100 acres by July 11. At this time maple and oak had been in some cases stripped but the white birch was at that time practically untouched. By July 23, however, the birch had succumbed also.

Isolated maple groves as well as maples present with beech in forest growths were stripped often by the saddled prominent

alone and sometimes helped out by the green striped maple caterpillar, *Anisota rubicunda,** which has been for two years very numerous. Similarly the attack by the saddled prominent on the oaks was reinforced by the rosy-striped oak-worm, *Anisota virginiensis.**

As to what happened to apple orchards in the infested districts Figure 32 is sufficient explanation.

Yellow birch seemed avoided at first and several reports came in "everything stripped but yellow birch" but larvæ of this species were seen actively feeding upon the yellow birch at East Sangerville and elsewhere later in the season.

Sumac was in several instances reported stripped but in every case investigated by the writer this was due to an undetermined small green caterpillar which made a general raid of the sumacs this season.

Saddled prominents were observed to be feeding also upon witch hazel, poplar, blackberry, mountain maple, spirea, cherry, and undoubtedly a full list of food plants would be very long.

The order in which various species of trees were taken seemed to vary in different localities but everywhere the beech was given preference.

The following extracts from letters give the food plants most attacked and are indicative of the extent and time of most conspicuous infestations. In each case the inquiry was accompanied by specimens of the saddled prominent.

July 18, 1908. Douglas Hill, Cumberland County, Maine. "Sunday they stripped fully 50 acres of forest trees here and are still at work very rapidly. They are also on apple trees."

July 28. Dover, Piscataquis County. "I am sending several worms taken from maple trees. They are eating the leaves from the tops or seem to work more in the top. May work downward later as I have just discovered them."

July 14. Bridgton, Cumberland County. "Some green worms are covering our apple trees in large numbers and are doing great damage."

July 16. Naples, Cumberland County. "What species of worm are these on nearly all hardwood and fruit trees? Beeches seem to be the ones they prefer."

---

* See Maine Agric. Experiment Station Bulletin No. 162 Insect Notes for 1908.

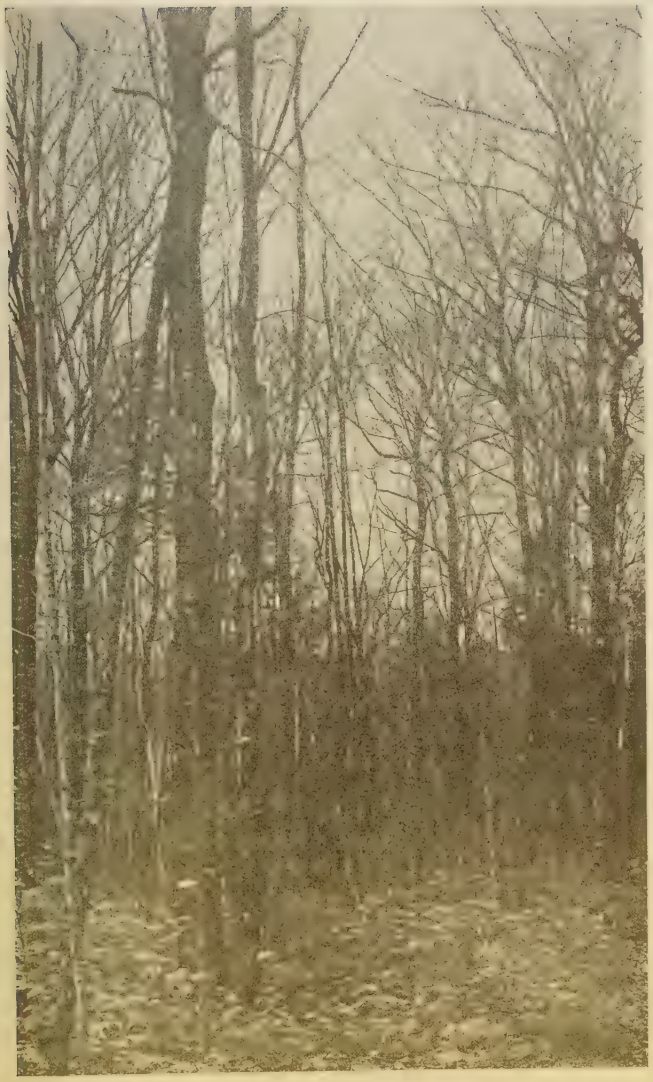
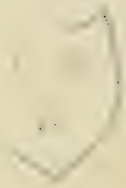


FIG. 31. Work of the saddled prominent in beech growth. Photograph taken at Upper Gloucester, Me., July 23, 1908.

FIG. 32. Orchard stripped by the saddled prominent, on the estate of J. H. Jones & Sons, Hampshire Hill, Mercer, Me., July 20, 1908. Photograph loaned by Mr. Fred R. Jones.



July 16. Lovell, Oxford County. "The green worms have stripped whole orchards of leaves."

July 19. Sebago Lake, Cumberland County. "I first saw these worms in this section last spring when they began attacking the beech, birch and maple on several hundred acres. This year they have become much worse."

July 20. New Sharon, Franklin County. "These caterpillars have eaten off all the foliage from many of the trees, both apple and hardwood. They are especially prevalent on beeches."

July 20. Stark, Somerset County. "These caterpillars are stripping the hardwood trees in this part of the town."

July 20. N. Waterford, Oxford County. "Some green worms are eating *all* the leaves on the apple trees and take the maple and beech."

July 20. Shapleigh, York County. "They have stripped the leaves from 100 acres of forest, and are also working on fruit trees."

July 20. Livermore Falls, Androscoggin County. "I send specimens of green worms which are devouring both shade and fruit trees."

July 21. Lovell, Oxford County. "Am sending a box of *Heterocampa guttivitta*. They have proved very destructive in this vicinity. Several hundred acres having been traversed by them and are almost devoid of leaves. Our orchard is practically ruined for this year at least. Our shade trees are bare as winter except elm and oak."

July 21. Livermore Falls, Androscoggin County. "Several hundred acres have been so defoliated that they present a brown appearance like that of bare trees in winter. The caterpillars seem to prefer the beech and birches, but are also very numerous on maples and oaks and may be found on other trees."

July 22. Madison, Somerset County. "The worms are doing considerable damage, working chiefly in the top branches."

July 22. Norridgewock, Somerset County. "They are partial to beech and yellow birch."

July 22. Harrison, Cumberland County. "The forests in the south part of Harrison and the adjoining town of Naples are in an alarming condition. The beeches are as bare as in December. White birches, oaks and maples are suffering

severely. Apple trees are in a leafless state also. The same condition prevails across the lake in Bridgton."

July 23. N. Waterford, Oxford County. "I am sending you worms that belong to an army which are destroying all the hardwood save the poplars within about seven miles of here. Last year they started to eat in the town of Sweden cleaning up the woods so that with the exception of the poplars and evergreens they looked as bare as in late fall. This year they ate everything that leaved out in the old neighborhood and began to move toward us through the woods in great quantities. They are moving half a mile a day. They seem to crowd along the ground in swarms as soon as they strip one section of woods."

July 23. Bethel, Oxford County. "The worms have eaten the leaves all off about 500 cords of wood and they are so thick they can be gathered by the bushel."

July 23. Hiram, Oxford County. "I send you specimen of a worm that is eating the hardwood growth, stripping the trees over thousands of acres in a place."

July 24. N. Leeds, Androscoggin County. "Forests look as though a fire had swept through."

July 24. Freeport, Cumberland County. "Beech trees seem to fare the worst."

July 24. Shapleigh, York County. "A caterpillar that is destroying acres of woodland and apple trees."

July 27. Wiscasset, Lincoln County. "I am sending you green worms which have stripped the beeches and yellow birches completely and have nearly stripped the white birch and are now beginning on the maple."

July 28. Sebago Lake, Cumberland County. "They are eating beeches, oaks and birches. White maple and sugar maple have escaped so far. They begin at the top of the tree and work down until there isn't a leaf left upon the tree, they then drop to the ground with a thud and crawl to some other tree. The woods are full of them on the ground and they are traveling at a fearful rate."

July 29. Ross Corner, York County. "The Prominent (*H. guttivitta*) is doing the most damage, the one I send you on oak (*Anisota virginiensis*) comes next and the maple leaf caterpillar (*A. rubicunda*) last. Probably 100 acres of trees are all bare."

July 31. So. Paris, Oxford County. "They seem to prefer

beech, birch and maple. They strip a tree clean of leaves and take tree after tree."

August 1. Fryeburg, Oxford County. "The wretched infestation of these worms make life in the country difficult and destroy the pleasure of my hitherto beautiful summer home."

August 1. Gardiner, Kennebec County. "Worms that are destroying the foliage of beech, maple and birch in the forests."

August 5. Sebago Lake, Cumberland County. "I was in the woods yesterday and there are scarcely any of the Prominents to be found in the trees now."

Degree of Injury Due to the Saddled Prominent.

The question uppermost in the minds of owners of infested woodland is whether the stripped trees will die. While it is not possible definitely to predict the degree of injury caused by such an attack, the following statements are of interest in this regard. Weather is one controlling factor, hard winters, excessive drought, or other unfavorable climatic conditions occurring at the time of such a severe stripping of trees increase the danger of fatal results. Under ordinary conditions some species of deciduous trees will stand being stripped for 2 consecutive years, and recover from the shock. If other conditions are particularly favorable a 3 years seige may not prove fatal. Some species of trees will stand what others cannot. The beech growth at Upper Gloucester and North Fryeburg which the writer had under observation was thoroughly stripped in 1907 and leaved out heavily and well the following spring. At South Leeds, Mr. John O. Bates, at whose place a large maple grove was completely stripped by the saddled prominent both in 1907 and 1908 wrote on September 16, 1908: "The old growth maple all leaved out in good shape last spring. The leaves on the young maple tops were a pale yellow. This year the grove was stripped as bare as winter about the first of August. Last year the trees did not leave out again after being stripped. This year the maples have all leaved out and some of the limbs of the beeches have leaved out."

Other reports that the trees, particularly the maple, were releaving came from various parts of Maine during late August this year.

The fact that in general the infested districts were stripped about 2 weeks earlier this year than last seems to be due to the greater number of caterpillars this season, many growths being devastated before the caterpillars were nearly grown. This was an unfortunate thing for the caterpillars as, except for such as could reach fresh growth, there was nothing for them to do but "drop out of the trees and keep going up until they died" as one observer put it.

Natural Enemies of the Saddled Prominent.

Prophecy as to the condition of the caterpillars another season is as difficult as predictions concerning the state of the trees. There are, however, more definite statements to be made in this case.

INSECT ENEMIES.

Last year over widely separated regions the saddled prominent pupated in an apparently perfectly healthy condition. Predaceous bugs and beetles were numerous and fed upon the caterpillars to a considerable extent. Two counts were made for the proportion of parasites from pupæ collected this spring. From 255 pupæ collected at Upper Gloucester June 1, 1908, 190 moths emerged, and 15 parasites, the cause of death of the other 50 pupæ was perhaps largely due to injury in transmission or handling in laboratory. From 176 pupæ collected May 29 at North Fryeburg, 153 moths emerged and 5 parasites, the remaining 18 died probably from injury in transmission. In 1908 particularly about August 1, hymenopterous parasites were very abundant in the woods infested by the saddled prominent. Concerning about 40 species there is so far only such circumstantial evidence that they were present in regions infested by the saddled prominent and further observations will be made for these another season. *Pimpla pedalis* which passed the winter in the pupa of its host was bred by the writer from pupæ of *Heterocampa guttivitta* collected last spring and *Ichneumon sublatus** similarly bred was present this season in great numbers from North Fryeburg to Norridgewock, and was without question the most beneficial of the hymenopterous parasites.

* Determined by Mr. Crawford through the courtesy of the U. S. Bureau of Entomology.

FIG. 33. Male. FIG. 34. Male. FIG. 35. Female. FIG. 36. Female.

Ichneumon sublatus. The most beneficial parasite of the saddled prominent. See pages 340 and 343.

FIG. 37. *Podisus modestus.* Predaceous bug stabbing the saddled prominent. See page 343.

FIG. 38. Adult.

FIG. 39. Larva.

Calosoma. Predaceous beetle feeding upon saddled prominents.

Both sexes of this species are given as Figures 33, 34, 35, and 36. *Ichneumon sublatus* also emerged the middle of September from pupæ collected at Norridgewock the first of August. How many generations a year there are for *sublatus* in connection with the saddled prominent was not ascertained. The only seasonal data which can be given is that it passed the winter in the pupa of its victim and emerged early in June, that it was on the wing in great numbers (evidently freshly emerged individuals) the first of August in the infested regions and that the species also emerged in mid-September from pupæ of the saddled prominent. Of the various predaceous wasps, apparently attracted by the saddled prominent, species of Ammophilas were particularly abundant.

The larvæ and adults of *Calosoma* were numerous in the infested woodlands at North Fryeburg, Upper Gloucester, Norridgewock and Mercer during the season. Both the beetles and larvæ carried on an active warfare against the caterpillars and were found climbing the tree trunks for their prey though their supply of food was largely taken from the ground or a foot or two up the trunk. One of these beetles was, however, found on the branches of a small tree. Figures 38 and 39 illustrate two stages of this species.

The larvæ of *Calosoma* are also active in feeding upon the buried pupæ of the saddled prominent and were particularly fond of the fresh pupæ the contents of which they were frequently found to be devouring early in August.

Pterostichus lucublandus was especially abundant last spring under beech trees where the pupæ were hibernating. These and other common ground beetles unquestionably take their part in feeding upon these caterpillars.

Of the predaceous bugs which were numerous, *Podisus modestus* was most active in feeding upon the caterpillars of the saddled prominent. Figure 37 gives this species in a fairly characteristic position with its beak plunged into the caterpillar (this species it usually attacks a little behind the head) and braced back while it drains the caterpillar fluids. Tree trunks where these bugs were working were decorated with dead caterpillars half sucked and hanging limp like an inverted U, and little heaps of dead caterpillars at the base of the trees testified to the ability of these blood thirsty bugs.

Some undetermined species of predaceous bugs were found near the saddled prominents but none were so numerous as *Podisus modestus*. As this bug also feeds upon the caterpillars of the brown-tail moth * it should be recognized as a benefactor of considerable significance.

No effort was made to secure evidence in regard to the host of insect eating animals. Mr. Curtis A. Perry, Bridgton, reports a pair of pet skunks as being very fond of the saddled prominents, eating them voraciously.

STARVATION.

Before the middle of July at Upper Gloucester and other badly infested places large areas had been already stripped. This happened in many cases before the caterpillars were ready to pupate and though the caterpillars sought new feeding ground, as was evidenced by stripped orchards (see Fig. 32), hordes of the caterpillars never reached suitable food and died of starvation. These starving caterpillars would drop from one defoliated tree and climb others only to find that no food awaited them. Many climbed trees they could not eat when nothing remained for them but to drop or climb down and try another. Figure 40 shows a mass of such caterpillars that had congregated about the base of a hemlock tree the foliage of which they could not eat.

CONTAGIOUS DISEASE.

Where excessive numbers of caterpillars are present in one place, favorable conditions arise for the spread of disease. Late in July and in early August various species of caterpillars were attacked by a disease and in some instances practically the whole infestation of saddled prominents was wiped out. At Mercer and elsewhere countless thousands of these caterpillars died within a few days. They lay in heaps about the bases of trees, in masses about stones, and hung limp where they had fallen across the branches. Specimens of these caterpillars were examined by Doctor Lewis, Associate Plant Pathologist of this Station, who found that the disease was due to a fungus parasite but that bacteria set in among the sick caterpillars and hastened their decay. The destruction of the bodies

* See Me. Agr. Exp. Sta. Bul. No. 162 Insect Notes for 1908.

FIG. 40. Starving saddled prominents congregated about base of Hemlock tree, the foliage of which they could not eat. Photograph taken in stripped beech growth upper Gloucester, Me., July 23, 1908. See page 344.

was thus so rapid that after a few days of heavy stench, nothing remained of the plague-stricken caterpillars.

In localities where the caterpillars died this season in this wholesale manner, it would seem that little need be feared from caterpillar attacks for the coming year.

In what manner the fungus disease started is not known. Possibly it found entrance among the wounded caterpillars that predaceous bugs had stabbed. In one or two localities there seemed to be some indication that such was the case. Once well started it would not be difficult for the disease to spread rapidly for the fungus penetrates throughout the body of the caterpillar, and the spores are thrown to considerable distance in all directions so that they light upon caterpillars below, or upon parts of the tree over which healthy caterpillars would travel. *Podisus modestus* was observed repeatedly in close proximity to diseased caterpillars, and it is not unlikely that such bugs would transfer fungus spores from sick caterpillars to healthy ones.

It is worth recording in this respect that this fungus outbreak came in a dry season. At Hampshire Hill, Mercer, for instance, it had rained but twice in the month (July 17 and July 27) previous to the height of the fungus disease which occurred July 28 to August 1. This severe fungus attack at Mercer occurred over an area the altitude of which was from 680 to 1020 feet, reaching the summit of the hill. Although it was a particularly dry season, various species of caterpillars were attacked by fungus all over the State about this time, though in many localities the saddled prominents had become full fed and safely pupated before the fungus developed.

BIRD ENEMIES.

As a rule soft bodied caterpillars are soon checked by birds. In order to form some estimation of the role birds were taking in the present outbreak, observations of badly infested areas were planned for this year. This could not be carried out until late July and early August, and it chanced that each place selected for the desired data was experiencing a wholesale fungus attack which naturally interfered with bird diet.

The following list of Maine birds, however, gives species which are undoubtedly beneficial. Of these 45 are reported as

observed eating hairy caterpillars * in Massachusetts and the remaining 8 related more northern species would without doubt have the same habit. Any bird that will eat a hairy caterpillar will take a naked caterpillar like the saddled prominent with relish.

Yellow Billed Cuckoo, Black Billed Cuckoo, Hairy Woodpecker,** Downy Woodpecker,** Yellow Billed Sapsucker, Northern Flicker,** Kingbird,** Crested Flycatcher, Least Flycatcher, Phoebe, Wood Pewee, Blue Jay, American Crow,** Red Winged Blackbird, Baltimore Oriole, Bronzed Grackle, White Throat Sparrow, Chipping Sparrow,*** Song Sparrow,** Field Sparrow, Junco,** Towhee, Rose Breasted Grosbeak, Indigo Bunting, Scarlet Tanager, Cedar Waxwing,** Red-Eye Vireo,*** Warbling Vireo, Solitary Vireo,*** Yellow Throat Vireo, Black and White Warbler,** Nashville Warbler, Northern Parula Warbler, Yellow Warbler,** Black Throated Green Warbler, Black Throated Blue Warbler, Myrtle Warbler, Magnolia Warbler, Chestnut Sided Warbler, Ovenbird, Northern Yellow Throat, Northern Water Thrush,** Redstart, Catbird, Brown Thrasher, Winter Wren, White Breasted Nuthatch, Red Breasted Nuthatch,** Chicadee,** Wilson's Thrush,** Hermit Thrush,** Robin,*** Bluebird.

In recording the efficiency of birds as natural enemies to the saddled prominent and other caterpillars, the domestic fowls should not be scorned. Turkeys and hens though not applicable to forest conditions are exceedingly helpful in the orchard or about shade trees. By way of example may be cited a hen of Buckfield which ate without much pause 60 of the caterpillars which dropped from a tree that was given a sharp rap. A case to the point also is recorded by State Entomologist E. F. Hitchings * concerning a chicken weighing when dressed 1 3-4 pounds. The crop of the little fowl was so distended that its contents were examined curiously and were found to consist of 75 full grown caterpillars compactly disposed.

---

* Forbush, E. H. Useful Birds and Their Protection.

** Seen in stripped woodlands in Maine.

*** Actually observed feeding on saddled prominent.

* Maine Dept. of Agric., Augusta. Circular of Information on Forest Insects, 1908.

Combatative Measures.

ORCHARD AND SHADE TREES.

For the orchard or shade trees there are several practical measures which have proven successful the past season in preventing serious injury from the saddled prominent.

Spraying. This species is susceptible to arsenical poisons and the caterpillars readily died on apple trees which were thoroughly sprayed. Arsenate of lead or Paris green will kill these caterpillars and should be applied as soon as they begin appreciable work. Applications from the middle to the last of June would probably get all these caterpillars which hatched upon the trees. In case a migration to an orchard from an infested forest growth is feared, the orchard should be sprayed as soon as the caterpillars begin to travel in search of fresh food. If trees not already attacked are banded with a sticky substance, the ascent of caterpillars up the trunk will effectually be prevented.

Jarring and banding. The saddled prominents are readily shaken from the branches. The writer repeatedly has seen trees effectually cleared in this way for the past two seasons. Small trees can be shaken from the ground. With larger ones a boy can be sent among the branches to shake or give them a sudden jar, a proceeding which should begin with the top, of course. The cool of the morning is the most propitious time for jarring.

The caterpillars once dislodged, their reclimbing can be prevented by banding. The trunks of the trees are protected with a sticky band. A band of tarred paper thickly smeared with equal parts of lard and sulphur has proven helpful in such cases. This mixture should not be applied directly to the bark of the tree as there is danger of injury, but with the tarred paper it is safe and effectual. Tar hardens so quickly that it has not proven satisfactory in several cases where it has been tried this season.

A material useful in certain phases of the gypsy caterpillar campaign and sold under the name of Tree Tanglefoot has been recommended by this Station during the present seige of saddled prominents. "This substance consists principally of resin softened by the admixture of suitable oils. It is quite similar to that used in the manufacture of adhesive fly-paper, seems to

possess the merit of not injuring the trunks of trees, and is very effective in checking the ascent of caterpillars thereon." * Where the number of caterpillars jarred from the trees is excessive it is expedient to kill them. A hand spray charged with kerosene or gasoline is a useful means to this end.

Fowls and Pigs. Hens will devour these caterpillars greedily (see page 348) and if given the range of an orchard will eat great numbers of the caterpillars which drop to the ground or descend to pupate. Of course, where such an excessive infestation occurs as during the present season, it would not do to depend upon hens entirely but they would prevent great numbers from entering the ground to develop into next season's moths. A flock of turkeys would display even more commendable ability in this respect.

Pigs pastured in an orchard will, by rooting up and eating the pupæ, prevent great numbers of saddled prominents and other moths from emerging and depositing eggs for the following season.

FOREST TREES.

For such phenomenal outbreaks as the present no artificial measures are practical in forest growths. If the saddled prominents were likely to appear in excessive numbers year after year, wholesale spraying or other combatative measures might be advisably applied as with the gypsy caterpillars. But the saddled prominent, like other native species, is ordinarily held in check by birds, insect enemies, field mice and other animals which feed upon it in its various stages, by fungus diseases or by weather conditions. A moth ordinarily so guarded has never been known to remain uncontrolled by natural agents for more than a few years in succession, and in extensive woodland growths there is in this case apparently nothing to be done except to wait for natural conditions to readjust themselves.

---

* A. H. Kirkland. Second Annual Report of the Superintendent for Suppressing the Gypsy and Brown-tail Moths, page 150.

BULLETIN No. 162.

INSECT NOTES FOR 1908.*

EDITH M. PATCH.

The present bulletin, like others of the series, is concerned with certain insects of Maine which have come especially to the notice of the Station during the current season. In some cases the records are merely statements of insect situations which it may never be desirable to spend more time upon; in other instances the records serve as a preliminary note of species to be dealt with more fully at some future time. The summer of 1908 has been one of tremendous insect interest; the devastation of thousands of acres of hard wood forests by the saddled prominent; the prevalence of almost innumerable other species of caterpillars; the conspicuous appearance of pine insects, many of them usually rare, at a time when the pines are weakened from other causes; the noticeable great numbers and extent of aphid infestations; the continuation of grasshopper depredations; may be mentioned among the insect disasters of the season. Over against this we have as a bit of encouragement, the noticeable increase of predaceous and parasitic insects all over the State and late in July and in August a pretty general occurrence of a contagious fungus disease which struck various species of caterpillars like a plague, killing them by wholesale and thereby diminishing in many localities the danger of the succeeding generation.

For many items of interest the Station is indebted to people from different parts of the State who have kindly submitted important material. Such aid, although considerable, is too miscellaneous and disconnected to acknowledge separately and it is hoped that Insect Notes for 1908 will be accepted as a statement of appreciation of whatever suggestions or aid have been given the Station this year.

---

* Papers from the Maine Agricultural Experiment Station; Entomology No. 32.

So far as practicable "remedial measures" are not discussed here for the reason that descriptive circulars dealing with the standard injurious insects of the State are always on file to be mailed to persons requiring such information.

Station notes were recorded this season for something over 300 lots of insects, selections from which are contained in this bulletin. The Lot numbers here given are merely reference to Station records for the species in question and have no significance beyond permanently linking the published account to the Station collection and notes which is in some cases desirable.

The Gypsy and Brown-tail Moths.

As dangerous insects in this State, these moths are of first rank. Little need be recorded of them in this present bulletin as they are discussed adequately in so much constantly available literature. Descriptive circulars are sent out both by this Station and the Maine Department of Agriculture and the United States Department of Agriculture in reply to inquiries. For information concerning their present status and the work in progress against them for this State the reader is referred to the annual reports of the State Entomologist. The annual report of the Superintendent for Suppressing the Gypsy and Brown-tail moths in Massachusetts, are of no less interest to the neighboring states, as the gigantic experiments with introduced parasitic and predaceous enemies of these moths concern not the one state alone but the country at large which will benefit from the successful work carried on there. The value of such work cannot be over estimated either from the standpoint of scientific or practical demonstration.

While the owners of infested trees are for the most part alive to their responsibility as individuals, now and then careless owners of neglected trees still harbor the winter nests of the brown-tail moth evidently trusting to the fates or the State to prevent the consequences. The latter is proving itself willing to help most materially and that the fates are also propitious is indicated by specimens of a predaceous bug (nymphs of probably *Podisus modestus*) received with a nest of brown-tail moths from Stroudwater, Maine, September 4, 1908, together with the comment that there were "one or more in each of the 5 nests examined, feeding upon the young caterpillars."

THE SADDLED PROMINENT, *Heterocampa guttivitta* Walk.

By far the greatest amount of damage caused by any single species this season was due to the saddled prominent caterpillar. So enormous was the work of this insect that it seemed expedient to discuss it in a bulletin * by itself and it is mentioned here merely to include it among the insects of the year. A newspaper circular from this station was sent into the districts most infested about the middle of July, with a description of the pest and such remedies as were applicable to shade and orchard trees.

Associated with the saddled prominent the two species next to be mentioned were present in greatest numbers.

THE ROSY-STRIPED OAK-WORM, *Anisota virginiensis* (*pellucida*). Lot 309.

Found feeding upon several trees but everywhere especially upon the oak which they completely strip, is a darker relative of the green-striped maple worm. In many localities the work of the saddled prominent was greatly augmented by these two caterpillars. This oak worm is variable as to color but in general it may be described as a dark grey or greenish larva with dull brownish yellow or often brick red lateral stripes, and the skin is dotted with small white warts. A row of short black spines occurs on each segment and there are two long spines on the second thoracic segment. The winter is passed in the pupa similar to that of the maple-worm and in the same situation,—among fallen leaves beneath the trees the caterpillars have stripped.

The moth emerges early in June. Professor Comstock's description is quoted:

"The wings of the female are purplish red, blended with ochre-yellow; they are very thinly scaled, and consequently almost transparent; and are not speckled with small dark spots. The wings of the male are purplish brown, with a large transparent space on the middle." The male is considerably smaller than the female.

Figures 41, 42 and 43 represent the caterpillar and the moth of this species.

---

* Maine Agricultural Experiment Station Bulletin No. 161.

THE GREEN-STRIPED MAPLE-WORM, *Anisota (Dryocampa) rubicunda.* Lot 325.

So numerous upon the maple have been these caterpillars for two seasons, in many cases entirely defoliating the trees, that the following description and accompanying illustrations are given. "The larva measures when full grown about one and one-half inches. It is pale yellowish green, striped above with 8 very light, yellowish-green lines, alternating with 7 of a dark green, to black. There are two prominent spines on the second thoracic segment, and two rows of spines on each side of the body, one above and one below the spiracles, and on the 8th and 9th abdominal segments there are four prominent dorsal spines." *

The species passes the winter in the pupa state and pupæ were commonly found in the same situations as those of the saddled prominent under the fallen leaves in the infested maple growths. The moth which emerges in the spring (for Maine about the first of June) is an exquisitely beautiful moth with wings of pale yellow banded with rose pink.

Symmerista (Edema) albifrons.

The White Tipped Moth. Lot 386. Among the forest caterpillars this season, the larva of this moth was very common. This caterpillar was taken on oak, birch and other trees. "It is smooth and shining, with no hairs. Along each side of the back there is a yellow stripe, and between these, on the back, fine black lines on a pale lilac ground; on each side below the yellow stripes there are three black lines, the lowest one just above the spiracles. The head is orange-red; and there is an orange-red hump on the eighth abdominal segment." (Professor J. H. Comstock-Manual). The conspicuous orange-red at each end of the caterpillar together with its rather peculiar shape make it a little puzzling to tell whether one of these caterpillars is traveling backward or forward.

* Professor J. H. Comstock. Manual p. 349.

A New Spruce Tortrix, *Argyroploce abietana* Fernald. Lot 237.

Spruce twigs with the needles dead and webbed together in a silken mass were received from South Paris, May 20, 1908, with the complaint that two small spruces were much injured in that way. See Fig. 44. The inside of the leaves had been eaten out by the larvæ which entered by a hole made near the base of the leaf. The webbed mass contained small felty cocoons with greenish pupæ inside. Upon request a considerable mass of the webbed twigs was sent from the same place and over 40 of the numerous moths which emerged were mounted. These were not previously in the Station collection and were submitted to Doctor C. H. Fernald who kindly named and described * them. The females differ in no conspicuous marking from the males described by Doctor Fernald. The wing expansion, however, should read 11-13 mm. instead of 21-23 mm. as appearing by mistake in the original description. The accompanying photographs Figures 45 and 46, will give a general idea of the color pattern of this species. The fore wings might be briefly and graphically described as being composed of alternate irregular transverse bands of brown and bluish or silvery white. Accompanying the description of the male moth Doctor Fernald quotes Miss Rose L. Davis concerning the larvæ as follows: "The larvæ, when full grown, are about 7 mm. in length, cylindrical in form, with the head of medium size, of a shining yellowish-brown colour, and with a few fine hairs scattered over the surface. The rest of the body is of a light greenish-brown colour, semi-transparent. The thoracic and anal shields are of a pale greenish colour, with the usual fine hairs on these and over the surface of the body. When disturbed they quickly let themselves down by a silken thread."

The cocoon is a firm gray structure about 7 mm. in length and covered with pellets of frass.

The moths began to emerge May 29, so that it would seem probable that there are two broods a season. Since the cocoons are made among the webbed twigs the most practical remedy would seem to cut and burn such branches before the last of May. This would be applicable to shade and ornamental spruces and would prevent or greatly reduce the succeeding generation.

* The Canadian Entomologist, Oct. 1908, p. 349.

A New Noctuid for the Apple, *Crocigrapha normani* Grote. Lot 40.

During the season of 1907 larvæ of an undetermined species were bred upon apple in the insectary. These pupated about mid-July and in the spring a single moth emerged in the laboratory. This was identified by Doctor Harrison G. Dyar as *Crocigrapha normani* Grote, who stated that nothing was recorded of the life history of this species. Some descriptive notes in regard to the earlier stages which had been made by the writer have been published elsewhere,* and need not be further recorded here.

Acrobasis (*Phycis*) *rubrifasciella.* Lot 264.

About the midle of June most of the sweet fern in the vicinity of Orono and also at Lewiston was found to be attacked by these caterpillars which constructed trumpet shaped tubes. These tubes were composed of silk into which were woven more or less regular circles of dark frass pellets. The more perfectly formed trumpets were beautiful structures. Later the open mouths of the trumpets were closed before the larvæ pupated so that the cases were then rather oval in structure. Several masses of these were gathered and July 11, 1908, the moths began to emerge. The wings expand about 3-4 inch. When the moths are at rest they hold their wings curled about the body and the antennæ are stretched back straight against the mid-dorsal line.

On June 29 apparently the same sort of cases were received from Dexter, Maine, where they were taken from white birch.

Deilephila galli.

Sphinx caterpillars on *Galium verum.* Lot 298. One of the most curious of the season's collections was made July 16 when a bunch of yellow or ladies bed-straw was brought into the Station with about 20 young sphinx caterpillars upon it. This introduced plant was in full blossom and growing in profusion over a limited area. The caterpillars upon it were about 1 1-2 inch long with head and body bright green. See Fig 47. There was a mid dorsal yellowish white unbroken line, and a similar yellowish line just ventrad the spiracles. Midway between

* Entomological News. July 1908, pp. 321, 322. Plate XIII.

these two lines was another yellow line of the same width broken by 9 reddish spots edged with a curve of black along the sides, the posterior pair of red spots forming a Y with the caudal spine for the stem. These larvæ were unknown to the writer in this stage as was the plant upon which they were found, and it was after a half day's search that either was placed when, curiously enough, both were located on colored Table 7 of *Die Raupen der Schmetterlinge Europas* by Hofmann-Spuler.

The fact that this sphinx had discovered, in a Maine meadow, the first bit of this European plant known to appear in this locality and one of its favorite food plants in Europe seemed particularly interesting. Within a few days the caterpillars molted and were then the characteristic color of full fed *D. galli* (*chamoenerii*) larvæ which the writer had taken on fire weed (*Erechtites hieracifolia*), strawberry leaves and other plants previous years. That the *Galium verum* was a favorite diet is evidenced by the difficulty with which these caterpillars were induced to feed upon other plants when the supply of "bed straw" gave out. Several plants reported for this sphinx were tried but the caterpillars, after reveling in the sweet scented yellow blossoms of the *Galium*, sturdily declined leaves of any sort and were tempted only by the blossoms of fireweed, on which they fed until they pupated. Figs. 48, 49, and 50 picture moth, pupa, and full fed caterpillar of this species.

Datana major. Lot 394.

Several of these handsome caterpillars were received from Harrison, Maine, August 27, 1908, where they have been numerous upon "Deerberry," (*Vaccinium stamineum*) for two seasons. They fed in the insectary upon common low blueberry. The writer is not aware that this species has been previously reported from Maine. The specimens received were black bodied with 4 heavy longitudinal lines of pure white, broken into subquadrate spots. Head and cervical shield deep rich red, anal plate and prolegs red, the thoracic legs red at the base but the distal portion black. The body was thinly covered with short black hairs and longer whitish ones. The caterpillars assumed the characteristic Datana attitude, resting with both extremities raised, sometimes slightly, sometimes nearly meeting over the body.

Ogdoconta cinereola.

Bean Worm. Lot 231. This is a slender naked green caterpillar, pale with darker longitudinal stripes, measuring when full fed a little more than an inch in length. It was troublesome over the greater part of the State on beans this year, in many cases stripping the vines bare of foliage and pods. At the slightest touch they give a series of violent jerks landing on the ground. Their contortions are laughable even when their depredations are serious. Their habit of jerking off from the plant would seem to make killing them upon the ground practical, or in gardens to which hens have access merely shaking the infested vines for the benefit of the hens might prove a sufficient remedy. With shell-beans arsenical sprays would be practicable.

Alcothoe caudata.

Clear winged moths (Lot 322) were common flying about blossoms of Virgin's Bower (*Clematis virginiana*), August 3, 1908, at Mercer, Maine. The moths were mating at that date. The larvæ of this species bore in the stems of clematis.

Estigmene acraea and *Diacrisia* (*Spilosoma*) *virginica.*

The hairy "yellow bear" caterpillar of these two species were overwhelmingly troublesome in vegetable and flower gardens all through the State this year.

Basilona imperialis.

The Imperial Moth. Lots 329 and 379. Two full fed larvæ of this moth were received this season on white pine, the one from Naples, Maine, August 11, being the bright yellowish green variety, and the one from North Berwick, August 15, being dark brown. See Figure 51.

Lapara bombycoides.

Pine Hawk Moth. Lot 315. Several larvæ of this moth were received on white pine. This striking caterpillar is particularly inconspicuous in its natural habitat, as when it lies longitudinally along the pine needles—its normal attitude—the green stripes have so much the appearance of the needles that the insect is not noticeable. See Figure 52.

Dibolia borealis Chev.

Plantain Flea Beetles. Lot 279. Every season the bronze green flea beetles of the plantain, *Plantago major,* are found feeding upon the leaves of this plant early in the season and again later in the summer. This year they were found very plentiful near Portland mating May 25. At Lewiston, July 3, plantain leaves thoroughly mined, (See Figure 53) were found over an area of several square rods. The leaf miners in the trails were at that time full fed. A collection of leaves was made and the larvæ deserted the trails and buried themselves in the earth furnished them for pupation. On July 27 several of the fully developed beetles had emerged from the soil and proved to be *Dibolia borealis* Cherv. (=*aerea* Melsch). This beetle passes both the larval and adult life on the plantain. Whether there is a second brood for Maine has not been ascertained.

Oberea bimaculata.

The Raspberry Cane Borer. Lot 261. For the past two seasons this insect which had been very little in evidence for some time came to the front again. The writer is informed that about 12 years ago the injury by this borer to blackberry canes in this State was quite extensive, and it is blackberries that have been most attacked for the past two seasons although both at Orono and elsewhere the raspberries have been taken also. One man explained: "The tops of my blackberries kept lopping down and I thought at first the children were doing the injury in thoughtless sport. But I sat where I could watch the vines one day and saw several tops go down without apparent cause. When I looked at these lopping canes I found two magic rings upon them. The thing is pure witchcraft," the owner of the canes added with a puzzled laugh.

Two "magic" rings (See Figure 54) are indeed at the base of the drooping portion of all canes affected in this manner. They are about one-half inch apart and are the two rows of punctures made by the adult beetle with her jaws. Between them the beetle makes a small hole through which she deposits her egg.

Were the drooping tops the end of the injury usually not much damage would be done but the grubs which hatch from

the egg bore down the cane. Professor Slingerland's excellent account * of the work of this boring is as follows:

"They are cylindrical, footless, yellowish grubs, measuring about three-fifths of an inch in length. When first observed in the latter part of July they had made in each case a burrow less than two inches in length; but after that date the burrows were rapidly extended downward so that they became in many cases two feet or more in length and reached the base of the canes. The burrows are about one-eighth of an inch in diameter; they wind from side to side of the pith, and at frequent intervals penetrate the woody part of the cane. In some of the cases where the woody part of the cane is penetrated an opening is made through the bark. These openings occur at intervals of a few inches throughout the length of the tunnelled portion of the cane; they are small, being about one-third of the diameter of the burrow; and their object is to enable the larva to deposit its excrement outside of the burrow. It is evident that the larva puts the caudal end of the body at this opening and forces the excrement directly into the open air, for it was found in long strings, some of them a half inch in length, on the sand below the openings; and the burrows were always free from it."

The remedy is obviously simple. As soon as the tops begin to wilt the affected cane should be cut off below the lower ring and destroyed. If this is consistently attended to in the spring the insect will be killed in the egg before any real injury by boring is done. When the trouble is not noticed until later in the season all affected canes should be pruned to the ground and burned.

On June 29, 1908, some canes in the University garden showed evidence of the work of this insect and July 3 the beetle was observed at work. July 8, raspberry canes that grew close by the blackberry bushes showed the girdlings by the beetle.

From Bridgton, Maine, September 28, 1908, came the following communication: "I am about to send you red raspberry tops in which are some small whitish grubs. The first signs of these grubs are noticed about the middle of July. A couple of rings of holes appear near the tops of some of the new canes. The tops wither and the grubs bore down the inside toward the

* 1890. Bul. Agric. Exp. Sta. Cornell University. Entomological Division XXIII.

earth. I have found them when they have bored nearly the whole length of the cane."

The beetles pass the pupal stage at the roots of the cane and emerge in the spring. The beetle has a narrow black body about long, the thorax is yellow, with 2 small black spots sometimes absent, while in some specimens there is an additional black spot at the posterior margin of the prothorax.

Among the accounts of this insect might be mentioned that of F. M. Webster * who observed it boring in apple and in witchhazel and that of O. Lugger.**

Osmoderma scabra Beauv.

The Rough Flower Beetle. Lot 399. In an old orchard where the apple trees were being cut a considerable number of the white grubs of this beetle were found. About 10 of these were kept the winter of 1907-08 in the laboratory living in a section of decaying apple trunk to which no other attention was given than soaking it up now and then. Two of the beetles emerged during the winter and to the others were added about 20 more grubs of various sizes during the summer of 1908. These lived in confinement with very little care and were kept until the edible portion of the trunk had been disposed of.

Although these grubs do not occur in healthy trees, they sometimes cause considerable injury by consuming the wood of old trees and inducing more rapid decay.

Figure 56 pictures the cell which this grub constructs by cementing together "sawdust" inside which cocoon it passes its pupal stage and from which it emerges in the winged or beetle stage.

Figures 55 and 57 give the grub and beetle.

Dermestes vulpinus Fab. Lots 227 and 400.

Two infestations of this Dermestid were reported. They were breeding in "tankage," that is refuse from a rendering place, to be used as a fertilizer. They were also at work in curd from dried buttermilk. The buttermilk is evaporated, the curd pressed, dried, ground, and put into two bushel sacks to be used for sizing paper. It was in these sacks that the beetles

* 1898. Bulletin No. 96. Ohio Agricl. Exp. Station.

** 1899. Fifth Annual Report of the Entomologist of the Experiment Station of the Univ. of Minn.

were breeding enough to be troublesome. The species was determined by Mr. Schwarz through the courtesy of the United States Bureau of Entomology.

Corticaria ferruginea Gyllenhal Lot 291.

Dense swarms of these minute beetles occurred at Orono in the early evening of July 13, 1908. At that time a forest fire was raging west of Orono and the wind was from the west at the time the beetles were taken. Whether the beetles were escaping from the burning district or whether this circumstance was merely a coincident was not ascertained.

Brachys aerosa.

These Buprestid beetles (Lot 249) were common upon oak the leaves of which they were eating in the vicinity of Portland May 25, 1908. The larvæ are leaf miners. The beetles were by no means so numerous as last season in the same localities, as recorded on p. 270 of Bulletin No. 148 of this Station.

Dendroctonus terebrans.

The Turpentine Bark Beetle, Lots 244 and 300, were abundant at North Fryeburg, May 29, about windows and were reported in numbers from East Denmark, July 14.

*Monohammus titillator** Lot 302. Sub. 1.

Monohammus scutellatus Lot 302.

Two of these pine borers were received from Ross Corner, July 17, with the comment "They had about stripped one side of the tree" (a small white pine). Being in doubt as to whether the stripped pine was the work of these beetles, as sawflies were pretty generally numerous, the writer placed the beetles in a jar with fresh pine twigs and they very soon began to chew along and through the needles, strewing the bottom of the jar with the needles which they had nipped through.

* Determined by Mr. Schwarz through the courtesy of the United States Bureau of Entomology.

Cryptorhynchus lapathi.

The Poplar and Willow Borer. Lot 327. This insect which has been a serious pest in other states was observed on the campus for the first time in 1907, a single specimen being taken from a willow hedge, June 7. This season from the same hedge these beetles were taken in several collections. On August 10 the females were observed chiefly upon new growth and some were found with beaks buried in the bark. At this date also they were mating.

Conotrachelus nenuphar.

Plum Curculio as an Apple Pest. One of the most serious apple pests in the State is the plum curculio. Besides the young apples which fall in quantities and in which the weevils develop, the fruit remaining upon the trees is so often and so generally deformed that it is seriously injured. As is the custom of the Station in regard to orchard pests, a circular of information concerning the work and remedies for this insect is used for full reply to questions about injuries due to the curculio.

Aphrophora parallella.

The Parallel Spittle-Insect, Lots 319 and 326. In June, deposits of white froth were observed generally upon the white pines of the State and the young insects found in the froth were frequently received with the question "are these the cause of the 'pine blight?'" The full grown insects were abundant on the white pine in the vicinity of Sebago Lake late in July, and the specimens were determined by Mr. Heidemann through the courtesy of the Bureau of Entomology, Washington, D. C.

Eriopeltis festucae.

The Cottony grass-scale was present as usual which means parasited as usual. It could be found in localities where it has been observed previous seasons but there were no complaints of serious injury to meadows.

Leptoterna dolobrata.

This meadow insect could be swept up by hundreds in the net about June 30 in the Orono grass lands. They exhibited great variation both in color and in length of wing covers.

Canthophorus cinctus Lot 392.

August 26, great masses of the red and black nymphs, in several stages and the black and white adults of these bugs were found congregated under chips and bits of rubbish. This seems to be the hibernating habit of this species as such masses are frequently met with late in the fall.

Anasa tristis.

Squash bug. Strangely enough, the specimens sent from Gorham, Maine, July 14, 1908, were the only specimens of these squash bugs received by this Station in 5 years.

Lygus pratensis.

The tarnished plant bug, Lot 308, was present among blackening and withering tips of potato vines at Waldoboro, July 20 where it was reported to be "working quite extensively in potato fields."

Podisus modestus.

Surely this species of soldier bug deserves honorable mention as it was busily engaged in stabbing destructive caterpillars during the entire season, over all parts of the State.

Aphididae.

The plant louse collections have been more than 100 this summer and the material has been of considerable interest including some new species as well as unrecorded forms of named species. The dry warm season has proven a favorable condition for aphid life and the weather was particularly good late in September and October when the true sexes are to be found. As is to be expected, parasitic and predaceous enemies of the aphids were abundant and many infestations were controlled by such natural enemies.

Nematus erichsonii and Other Sawflies.

Larvæ of the Larch Sawfly, Lot 383, were taken at West Houlton, July 7, 1908. Sawflies of many species seemed especially common upon the wing this season, and a considerable number of undetermined species were collected.

Lophyrus abietis.

Spruce Sawfly. Lot 323. "All the fir trees in this vicinity are dying" was the complaint which accompanied large sendings of cocoons of the spruce sawfly from Orrs Island and some other localities this season. The sawflies emerged about September 9, 1908. This is a well nigh impossible pest to fight in the woodland and the very serious trouble of this season added to last season's attack by the same species is rendered a little more hopeful by the fact that parasites emerged this spring from cocoons which were received from Seeket last year. The attack seems to have been more general upon the fir than the spruce.

Hymenopterous parasites.

Tiphia inornata, Lot 228, parasitic upon the white grub, were very numerous. Cocoons of these beneficial insects were received from South Thomaston, April 30, with the statement "I am planting new ground to potatoes and find an unusual quantity of the enclosed."

Chelonus sp. were bred from the tiny spruce tortrix, *Argyroploce abietana* Fernald. *Ichneumon sublatus* bred from the saddled prominent, was noticeable in woodlands all over the State. At Norridgewock as many as 10 or 12 were frequently to be found resting upon a single plant, about the first of August. At Mercer, August 3, one of these parasites was observed to be sipping honey-dew globules from a poplar leaf when an ant about one-third its size rushed at it and the Ichneumon took to its wings in haste. This comedy was repeated several times, as the Ichneumon would return to the feast of the honey-dew.

Pimpla pedalis also emerged from pupæ of the saddled prominent this spring.

As for parasites in general they were so abundant this season as to seem a prediction of fewer caterpillars another year.

Grasshoppers.

As was the case last year grasshoppers have been seriously troublesome this season. The red-legged locust, *Melanophus femur-rubrum* and *M. bivittatus* were guilty of most of the mischief, though the grasshopper kind in general were numerous and industrious. Among the other grasshoppers collected

this season as determined by Mr. Caudell through the courtesy of the U. S. Bureau of Entomology, are the following species *Nomotettix cristatus* Scudd. *Tettigidea lateralis polymorpha* Burm. *Cannula pellucida* Scudd. *Encoptolophus sordidus* Burm. *Stenobothrus curtipennis* Harr. *Stenobothrus curtipennis longipennis* Scudd. *Melanoplus collinus* Scudd. *Xiphidium fasciatum* De Geer.

At Mercer not far from the center of "the grasshopper region" the predaceous beetles, *Amara obesa,* was observed. As the larva of the beetle is credited with "devouring great numbers of locust eggs" its presence is one hopeful sign.

The grasshopper mites, *Trombidium locustarum,* bright red mites were present upon the grasshoppers of this locality being crowded particularly thicker about the regions of the wings.

Possibly correlated to the grasshopper scourge is the increase of the blister beetles, *Macrobasis unicolor* and *Epicauta pennsylvanica,* both species troublesome to potatoes and other crops but probably paying for such damage by the good which their larvæ do in eating such dangerous material as the eggs of locusts.

Fungus disease disposed of large numbers this season as last in spite of the dry weather.

Fungus Disease of Insects.

Late in July and early August it was observed over a region extending at least from Franklin to York counties that the caterpillars then feeding were overtaken by a contagious fungus disease. An account of such an attack of the saddled prominent is cited elsewhere.*

"White Pine Blight."

On account of the precarious condition of white pine in certain parts of the State considerable alarm has been aroused by various insects found upon the pine this season and indeed it has seemed as though an unusual number of species had taken advantage of the pines this year.

Besides the standard borers to be continually reckoned with, the pine sawflies and pine leaf eating caterpillars have made

* Me. Agric. Exp. Station Bulletin No. 161.

noticeable inroads, while spittle insects and plant lice (*Lachnus strobi* and *Chermes pinicorticis*) have been unusually prevalent.

None of these insects, however, have been the cause of the "white pine blight," * though several of them *Chermes pinicorticis* and the spittle insects, *Aphrophora parallela*, for instance, have been in some cases conspicuously associated with the ailing trees.

Eriophyes fraxiniphila Hodgkiss
and
Eriophyes fraxini (Karp.) Nal.
Ash Clusters and Gall Mites. Lot 429.

In the vicinity of Orono the red ash is commonly covered with distorted growth somewhat of the appearance of "witches' broom." Figure 58. In some cases these clusters hang from every branch and give the tree a strange appearance after the leaves have fallen. Examination of one such cluster taken October 10, 1908, revealed thousands of microscopic mites, some transparent and some pinkish, moving over the irregular surface. Similar galls are recorded by Murray as the so-called clusters of ash,† caused by an unnamed mite.

The mites that cause the physiological disturbance in the plant tissue which results in this erineum or gall are so small as to be almost invisible to the unaided eye. Examination of the gall under a Zeiss binocular gives a very interesting glimpse of these minute creatures on the gall and reveals the characteristic movements of the mites as well as their color and a general idea of their form. An oil emulsion, however, is necessary to give any definite details.

---

* A discussion of the "white pine blight" is given by W. J. Morse in a forthcoming bulletin of the Maine Agricultural Experiment Station, and by the same authority under the title "The White Pine Blight in Maine" in the Report of the State Forest Commissioner of Maine, 1908.

† "They are the monstrous deformed styles of the flower, which gather into a ball, brownish green at the beginning, later on a dark brown, causing rough masses on the upper part, which have on the outside a great similarity to fragments of the upper part of a cauliflower. Its upper side is clothed, as it were, with colourless hair cloth, from which come stick like hairs. They are solid, without any hollow space, and, in a dry state so hard that they can be sawn and cut like wood." Economic Entomology, Aptera, p. 364.

No observations were made in regard to natural enemies except that a white mite resembling somewhat the figure of "an enemy of the blister mite" * was found October 13 upon one of the galls. A sufficient remedy would apparently be found in cutting off and burning the galls before the first of October.

As there seemed to be no record for America for the species of mites causing these galls, material was sent to Mr. P. J. Parrott through whose courtesy the following statements are made possible.

An examination of the material sent Mr. Parrott November 4 showed that the mites had left the flower galls but large numbers of Eriophyids were taken from the buds, in which the species responsible for the flower galls appear to hibernate. One of the two species present is *Eriophyes fraxini* (Karp.) Nal. which is said to cause flower galls on the European and the green ash in Europe. The other is a new species. This has been described by Mr. Hodgkiss and has been designated by him in his manuscript as *Eriophyes fraxiniphila.*

The brief description used here with the kind permission of Mr. Hodgkiss gives the following characters by which this mite may be recognized:

"Body long and narrow. Thoracic shield small. The dorsal setæ are of medium length and are widely separated. The legs are stout and the feathered hair has four rays. The thoracic setæ are present. The striæ on the dorsum and ventrum of the abdomen are narrow, closely punctured and number about seventy. Abdominal setæ are present. The third pair of thoracic setæ and the first and second pairs of ventral setæ are long. The females measure about 220 microns in length and about 40 microns in width, while the males average about 190 microns in length and 46 microns in width. The color of the mites varies from white with pinkish reflections to a deep salmon color in the hibernating forms."

---

* *Seius pomi* Parrott. N. Y. Agric. Exp. Sta., Bul. 283, plate IV.

Fig 41.

Fig. 42.

Fig. 43.

The Rosy-striped Oak-worm, Anisota virginiensis Fig. 41 male moth, Fig. 42 female moth, Fig. 43 full fed larva. See page 353.

FIGS. 44, 45 and 46.

Argyroploce abietana Fernald. A new spruce Tortrix and work of larvæ on spruce. See page 355.

FIG. 47.

Deilephila galli. Young sphinx as taken on introduced European plant, Galium verum, in Maine meadow. See page 356.

Fig. 48.

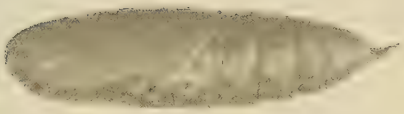


Fig. 49.

Fig. 50.

Deilephila galli, Sphinx. Fig. 48 moth, Fig. 49 pupa, Fig 50 full fed larva on fire weed. See page 356.

FIG. 51.

Basilona imperialis. Larva of Imperial Moth. See page 358.

FIG. 52.

Lapara bombycoides. Larva of pine hawk-moth. See page 358.

FIG. 53.

Dibolia borealis. Trails of leaf mining larvæ in leaf. See page 359.

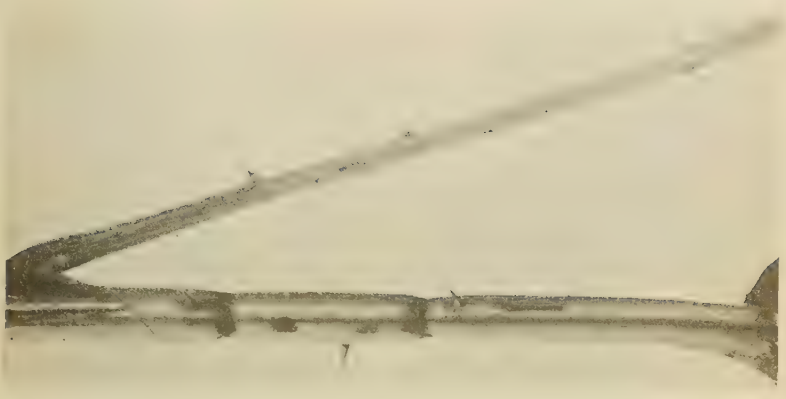


FIG. 54.

Oberea bimaculata. Work of adult beetle on blackberry cane. Enlarged. Orono, July 8, 1908. See page 359.

FIG. 55.

FIG. 56.

FIG. 57.

Osmoderma scabra. Fig 55 grub bred in decaying apple trunk. Fig. 56 cocoon. Fig 57 adult. See page 361.

Fig. 58.

Ash clusters caused by gall mites. *Eriophyes* sp. See page 367.

HOMOLOGIES OF THE WING VEINS OF THE APHIDIDÆ, PSYLLIDÆ, ALEURODIDAE, AND COCCIDÆ.*

EDITH M. PATCH.

INTRODUCTION AND GENERAL CONSIDERATIONS.

This study of wing venation was undertaken in the hope that it might, for the one small group of Homopterous insects it concerns, supplement in some slight measure other work in wing-vein homologies which has been so vital a problem for insect phylogeny.

The incentive to this study is to be found in "The Wings of Insects" by Comstock and Needham. The choice of the particular group here considered was due to a personal interest in aphids and to the fact that the homologies of the wing-veins of this family were at that time practically untouched.

From the first the work has been under the direction of the Department of Entomology, Cornell University and it is a pleasure to acknowledge the kindness of Professor Comstock during my association with this department as a student, and the patient aid and constant interest and sympathy in my task of Doctor MacGillivray.

To Professor Oestlund at the University of Minnesota is due thanks for the determination of certain species of aphids which are included in this study and for the personal interest with which he has anticipated the results.

Although the work has been entirely under the supervision of the Department of Entomology, Cornell University, the great bulk of the data has been accumulated at Orono, Maine, instead of Ithaca, New York. Several months of each winter during the grogress of the problem, however, have been spent at Cornell in revising data and in such consultation as has insured against certain misinterpretations and other errors due to inexperience in this type of work. At such times the essential points have been in so far as is possible with the greenhouse aphids available, verified while *in residence* in Ithaca, and the work with the Coccidæ and Aleurodidæ has been done in the Entomological laboratory at Cornell University.

Since 1903 each season's collection of aphids in Maine with detailed notes has given me a very fair idea of where to secure

* A contribution from the Entomological Laboratory of Cornell University, and Papers from the Maine Agricultural Experiment Station; Entomology No. 33

given species and upon what plants at any time during the entire season. This has given me a range of from 95 to 105 available species belonging to at least 10 different genera and representing all the types of venation in the entire family.

At the Maine Station two insectaries (one an unheated building of use only during the summer, and one a hot house), have both been available for the segregation of colonies of aphids taken previous to the development of wing pads in order that they could be used at exactly the right time. This made possible a large amount of material safe from the depredations of predaceous insects and parasites, a condition which could never be relied upon with chance collections in the open.

In view of the fact that for the work in hand, no specimen could be used for the study of wing tracheation except during the first few minutes after emergence from the last molt, and that the nymphs could be studied only during a very limited time before the developing wings became much folded in the sac, and that some species gave conspicuously better results than others by virtue of such reasons as the slightly different angle at which the wing pad of certain species are held, or to differences in color, etc.: it will be evident that the conditions outlined have been most propitious for the study of this particular problem with aphids.

The reasons for approaching the homologies of the wing veins of insects by a study of the tracheæ that precede the veins were so fully set forth and their validity so thoroughly demonstrated by Comstock–Needham* ten years ago that this phase of the question has long been too familiar to call for general discussion here.

However, with each new group of insects studied in this way conditions exist which may have a special bearing on the subject. For instance, an ontogenetic study of the wings of certain insects is not of any value in determining the homologies of the veins‡ in which case entire dependence must be placed on a careful comparison of the veins of the mature wing.

On the other hand with wings so highly specialized by reduction of veins as those of the Homopterous group with which this paper is concerned, the subject is a hopeless one to approach from

* The Wings of Insects. Amer. Nat. XXXII and XXXIII, 1898 and 1899.

‡ MacGillivray, A. D., Wings of the Tenthredinoidea 1906. Proceedings of the Nat. Museum. Vol. XXIX, page 574.

the comparison of the veins themselves. What chance is there on the basis of the mature wings alone to homologize except by the merest guess the veins of the Aleurodidæ with those of the Psyllidæ?

Yet fortunately and, in many instances, to my utmost surprise, it was found that practically the whole story of the venation of the group of four families here concerned lies revealed in the preceding tracheation and no one who follows that story closely can fail to recognize in the two surviving veins of Aleurodes for instance the radial sector and cubitus. (See page 122).

One of the simplest but prettiest and most clearly cut of the demonstrations of the value of the tracheation in this connection is to be found by comparing the venation and tracheation of *Chermes* which shows at once that it is the wavering and unstable R_1 which is lacking and not M as has heretofore been considered. (See page 111). And the vagaries of R_1 in the whole group form a fascinating study by themselves.

But exciting and interesting as is the story the tracheæ trace, the quest for the homologies of the wing veins of aphids has lain along a path tedious in many respects and beset with many difficulties.

The tracheæ of aphid wings are very delicate, and when filled with the medium in which the wing is mounted they become invisible, so that many of the examinations and sketches made had to be finished with rapidity, and often many mounts prepared to verify a single point.

The wings studied in connection with this problem were prepared in two ways. Part of them were mounted in glycerine jelly after the method described by Comstock–Needham* and part of them were mounted in xylene damar. With wings so small and delicate as the aphids wings the latter was found in the main more satisfactory. It took the balsam less time to penetrate and render the tracheæ invisible which would have been an objec-

*"In making mounts of this kind our usual procedure was to spread a drop of melted glycerine jelly on a slide and allow it to cool; then to dissect off the wings (generally under water), taking with them just enough of the thorax to include the basal attachments of the tracheae; then to place these wings upon the solidified glycerine jelly on the slide; then to lower upon the wings a heated cover glass, causing the jelly to melt enough to envelope the wings; and then to cool the mount speedily on a cake of ice, a marble slab, or in a draught of cold air. Rapid cooling is imperative, for in melted glycerine jelly the tracheæ soon become filled and the smaller ones are then invisible." The Amer. Nat. Vol. XXXII, page 45.

tion except that even the balsam mounts remained usable for a sufficient time to secure camera lucida drawings of the points in question. In preparations for photomicrographs the glycerine jelly mounts were better.

After comparing the two methods the balsam mounts were used almost altogether as they were quicker and simpler to prepare and a much larger proportion of usable mounts were made in this way.

The wings of freshly emerged aphids were severed from the body together with a portion of the thorax, to preserve the basal part of the tracheæ and to block to some extent the penetration of the balsam.

In some species, where the shape of the body and the angle at which the wings are set permitted it, the aphid itself with wings attached was mounted after beheading the insect and puncturing the tip of the abdomen. The legs had also to be removed. The pressure of the cover glass in these mounts generally forced the body fluids from the openings at the two extremities and often excellent tracheal preparations were secured in this way. It could be applied only to a limited number of species, however.

Only wings of freshly emerged aphids are available for the study of the wing tracheæ, as before the wings are hardened enough for the first flight, the tracheæ have become either entirely invisible or so nearly so that they are useless for the questions in hand. It thus becomes necessary to select the individuals in the first few minutes after molting. This can readily be done by taking the palest insects while the wings are yet white, that is, before they begin to become transparent. An abundance of material was kept on hand by the collection of large colonies of aphids whenever any were found, the wing pads of which indicated that the final molt was approaching.

It was more difficult to secure the wing pads at the critical moment. The wing pad of the aphid nymph is not only small but it is relatively thicker and softer and narrower than those of many insects and the developing wing is for the most part so crumpled that the courses of the tracheæ are impossible to follow. So soft is the tissue of the nymphal pad and so loose do the tracheæ lie within it, that the slighest pressure is likely to misplace them or rupture them, and render the preparation useless. By selecting the nymphs of such species as had the flatter wing pads,

the best results were obtained. However, none of the aphids are so easy to manipulate for the tracheation of the wing pads as are the flat padded psyllids.

* * * * *

Although the possibilities of interesting features of wing tracheation of the aphids were by no means exhausted with any species; for the problem at issue,—the homologies of the wing veins,—no point was left in question. Wings of more than two thousand of newly emerged aphids were examined. Where possible a single point was verified for all the variations of wing types from *Lachnus* to *Chermes*. Where a point arose that certain species showed better than others it was exhaustively studied by making numerous mounts of those species which had any bearing upon it.

As for the range of material used, approximately 100 species belonging to 16 genera were drawn upon. Many of these were discarded after a few mounts,—as for instance after the condition for the genus *Aphis* was clearly ascertained other species of this genus did not give additional data. Many species were found unsatisfactory to work with by reason of size, density of color or other conditions and were discarded after a few trials.

The genera from which most of the data were accumulated and in all of which the tracheation was demonstrated repeatedly and conclusively, are Lachnus, Melanoxanthus, Callipterus, Chaitophorus, Myzus, Macrosiphum, Rhopalosiphum, Aphis, Schizoneura, Mindarus, Pemphigus, Tetraneura, Hamamelistes, Chermes and two new genera still in manuscript. These genera present practically the whole variation of the types of aphid venation from the more generalized to the more specialized.

The more logical presentation of the four families considered in this paper would be in the following order,—Psyllidæ, Aphididæ, Aleurodidæ and Coccidæ, but as the problem was undertaken primarily for the Aphididæ and as the investigation was devoted for the most part to them, the part dealing with the aphids is presented first. The work with the other families, though sufficient to indicate the homologies of the veins, has been so much slighter in amount that it seems more fitting to give secondary place to the Psyllidæ even though this necessitates a break in the systematic sequence.

THE COURSE OF A VEIN.

In the following pages the "course" and the "free part" of veins are frequently mentioned. By the free part of a vein is meant all that portion that is not coalesced with any other vein. As for instance in Fig. 36, the free part of Cu_2 is all that portion of Cu_2 between the point where it separates from Cu_1 and the margin of the wing.

As to the course of the vein it has been convenient to consider each of the branches of any vein as extending from the base to the margin of the wing, as is made plain by the following quotation:*

"If radius and its five branches be taken as an example, the stem part, always designated as R, would be considered as being a combination of all the branches of radius, or as $R_1+_2+_3+_4+_5$, which divides into R_1 and R_{2-5}. In like manner the stem of the radial sector would be considered as being a combination of all the branches of the radial sector, or as $R_2+_3+_4+_5$, which divided into R_2+_3 and R_1+_5, and these in turn into R_2 and R_3, and R_4 and R_5, respectively. So that in tracing out the course of any of the branches of radius by drawing a pencil along them, as R_4, beginning at the base of the wing, we would pass first over the stem of R, then over the stem of the radial sector, then over R_4+_5, and finally over the free part of R_4."

COALESCENCE OF TRACHEÆ.

A comparison of the tracheation of the wing pad of an aphid nymph with that of the wing of the recently emerged aphid of the same species reveals the fact that there are fewer basal tracheæ in the later than in the earlier stage, although the terminal branches are the same in number. For instance, there are four tracheæ which branch from the body trachea in the nymphal wing pad of *Schizoneura rileyi* (fig. 21) and only two tracheal stems at the base of the newly emerged wing of the same species (fig. 22). Similarly as there are four tracheæ at the base of the nymphal wing pad of the species of *Aphis* which I have studied and of *Callipterus ulmifolii* while there are but two basal tracheæ in the newly emerged wings of these same species, this is shown to be the normal condition for the family in the more generalized genera. In the nymphal wing pad of *Mindarus* (fig. 18) three

* MacGillivary, A. D., Wings of Tenthredinoidea. Proc. U. S. Nat. Museum Vol. XXIX, page 576. 1906.

of these tracheæ unite before they reach the body tracheæ, approaching the condition of the mature wing.

This change in the condition of the corresponding tracheæ at different stages has been designated in this paper as the "coalescence" of tracheæ, as this term seems to express the relation of the tracheæ of the mature wing to those of the nymphal wing pad. This sort of coalescence of tracheæ is a constant factor in the aphids, not alone as to the main tracheal stems but a similar tendency is shown in the branches of the tracheæ. For instance notice that the medial trachea in figure 21 branches desidedly nearer the base of the wing than the medial trachea in figure 22, these branches being coalesced to much nearer the margin of the wing than in the earlier stage.

How or when this coalescence takes place the writer has as yet made no attempt to ascertain. No pains has been spared, however, in accumulating evidence that it does occur, or in making sure that it is an actual union of tracheæ and not an approximation. A 1-6 objective was usually sufficient for the examination of the cases in question. Where it was not, an oil emersion was used. The manner and time of the coalescence is a mystery well worth solving but it is only the *fact* of this coalescence and not its method which has any bearing on the present problem the homologies of the veins. However, it is a problem which the writer hopes to undertake in the near future.

Besides the normal coalescence of the basal portions of medial, cubital, and the first anal tracheæ just described, very rare instances of abnormal coalescence occur. Figure 2 shows a wing of *Melanoxanthus* in which the radial, medial and cubital tracheæ are anastomosed for a considerable distance.

Attention is also called to Plate XIX, which shows three unusual examples of tracheation. Normally the forewing of *Chermes* has two basal tracheæ as in the more generalized genera, and as is shown in figures 24 and 28. But in this highly specialized genus the tracheation seems to be unstable. Figure 26 shows an instance of anastomosis similar to that in figure 2, while figure 27 represents a single tracheal stem at the base of the wing, a condition which approaches the normal condition of the hind wing of *Chermes* (fig. 30.) On the other hand figure 25 records an instance where the first anal trachea is separate from the common stem of the medial and cubital tracheæ to the base of the wing, giving in this case three basal tracheæ.

In the study of the tracheation in the Psyllidæ the writer has been confined to a single species, and we have here even a more striking degree of normal coalescence of tracheæ than in the Aphididae. For instance, as is shown in figure 33, the seven tracheæ are distinct to the body trachea in the nymphal wing pad, while figure 34 records the normal tracheation of the freshly emerged wing, the three most important tracheæ, the radial, medial, and cubital tracheæ, are coalesced into a common stem at the base, and for a considerable distance the medial and cubital tracheæ are stalked after the radial trachea has separated from them.

We have, then, a very striking difference in the relation of the tracheæ of the nymphal wing pad and those of the freshly emerged wing, in both of these families of insects.

COSTA AND SUBCOSTA OF APHIDIDÆ.

The costal vein extends along the cephalic margin of the wing. No trachea precedes this vein in the freshly emerged wing.* Neither is a costal trachea present in any nymphal wing pad of the species examined by the writer. Further, no evidence of a vestigial costal spur from the body trachea is to be found in the several species examined for this point. Perhaps the most striking evidence of a costal vein aside from the stiffening of the costal margin is the fact that in severing the wing from a freshly killed aphid, the yellow body fluids frequently flow into this vein and extend along to about the region of the stigma (fig. 4).

In like manner no trachea precedes the vein subcosta in any species examined of the sixteen genera (see page 105) of aphids from *Lachnus* to *Chermes* which I have studied for this point. No item in this work has been more carefully investigated than the possibility of a subcostal trachea.

Indications of such a trachea have by no means been lacking. For instance, the fold of the vein subcosta appears very early in the freshly emerged wing (long before the other veins) and is therefore frequently the only vein indicated at the time the tracheæ are visible. For many mounts of many species this forming vein resembles a tracheal line closely enough to be mistaken for one unless exceedingly great care is taken to secure

* Comstock and Needham. Wings of Insects. Page 858. "* * * there are often channels present which do not contain tracheæ. This is oftenest true of two large channels at the lateral margins of the wing. Of these the costal remains abundantly lined with cells, which ultimately form the strong costal vein. Its trachea is often atrophied, probably owing to the disadvantageous position of its base in relation to air supply, as we have hitherto indicated."

wings immediately after emergence. Handlirsch* thus mistook this forming vein for a trachea in his preparation of *Schizoneura lanigera*.

Wherever there has been the slightest chance that a subcostal trachea might be present, exhaustive investigation has been made until no possible doubt of its absence remained.

Again, for some species, one of the secondary branches of the radial trachea near its base might easily be mistaken for a subcostal trachea so far as its position goes. *Chermes pinifoliæ* (fig. 26) serves as an illustration of this. But these secondary branches are very variable even for the same species and after examining large series of mounts little difficulty is experienced in distinguishing the tracheæ of the main veins from secondary branches.

The only trachea found during the whole time possible to interpret as the subcosta was a single mount out of hundreds of *Mindarus* (*abietinus* Koch?) where an exceedingly short branch from the radial trunk near the base occurred, larger than the ordinary secondary tracheæ. This may be an abortive subcostal not entirely atrophied. Or it may be merely an abnormality.

This species of Mindarus, collected in great abundance from Balsam fir in the vicinity of Orono is apparently the same as abietinus Koch. But as it has not yet been compared with specimens from Europe it is given in this paper accompanied with a question mark.

Another opportunity for confusing a branch of the radial trachea for a subcostal trachea is found in wings where the path of the tracheal branch of radius chances to coincide with that of the newly forming subcostal vein. Such a case is shown in the tracheation of *Pemphigus acerifolii* (fig. 12) where the trachea follows the stigmal margin that the subcostal vein is later to bound. But the branches of the radial trachea are quite as likely to cut directly across the path of the forming subcostal vein as to coincide. *Chermes abietis* (fig. 24) will illustrate this.

The point, however, which gave me most trouble was the fact that very frequently the fold in the wing caused by the forming subcostal vein bent the branches of the radial trachea to such an extent that their connection with the radial trachea was obscured and a series of tracheal branches resulted which had every appearance of rising directly from the region of the subcosta.

* Handlirsch, A. Fossilen Insekten. Plate VIII. Fig. 9.

The absence of a costal trachea is by no means unusual.* The aphid wing is characterized by the reduction of tracheæ and the loss of the subcostal trachea is only one more step in the general trend of reduction. What the aphid lacks in main tracheal trunks, however, it makes up in secondary ramifications, and a glance at the tracheation of *Chermes abietis* (fig. 24) will show that the absence of costal and subcostal tracheæ does not indicate that this portion of the wing is untracheated. Perhaps the abundance of secondary tracheæ explains the absence of unnecessary costal and subcostal tracheæ. At any rate they might in some cases be mistaken for one of these main tracheæ. Refer again to *Chermes abietis* (fig. 24) where the ends of the radial branches are so interwoven as to have the appearance of a continuous subcostal trachea. And where the channel of the subcostal vein hides the radial connection, we have frequently the occurrence of what appears to be a strong subcostal trachea with branches extending toward the radius. Further, in case the radial connection of all these tracheæ, except a single one near the base of the wing, is obscured, as sometimes happens, there is, to all superficial appearances, a clear indication of a strong subcostal trachea.

Altogether the absence of the subcostal trachea was one of the most troublesome points to establish. Each clue was followed, however, until the evidence was absolutely conclusive.

Although no subcostal trachea is present, there seems to be no other conclusion except to consider that the vein subcosta is present in the large main vein channel of the wing, and extends from the base of the wing to the stigma where it approaches the margin of the wing. Indeed it seems not at all unlikely that this stiff vein fold at the base of the aphid wing is responsible for the atrophy of the subcostal trachea. The radial trachea from its position can elude the pressure and run alongside, but this obstruction alone would seem sufficient to explain the loss of the subcostal trachea in the Aphididæ.

RADIUS OF APHIDIDÆ.

The tracheation of *Myzus cerasi* (fig. 3) gives a fairly typical two-branched radial trachea. This type persists for the family of Aphididæ except in the Chermesinæ where this trachea is not branched. This trachea is one of the two main tracheæ which enter the wing, and from the phylogenetic standpoint the chief

* See Footnote, page 108 (Costa and Subcosta).

interest concerning it is centered in the cephalic branch, or the trachea preceding vein R_1.

In the case of two widely separated Hemiptera, a Cicada and a Coreid, this trachea was found to be but weakly developed in the nymphal wing pads,* being apparently crowded out by the strong subcostal trachea, and it was not succeeded by a vein, the vein R_1 being completely absent in these two insects.

With the aphids no such crowding of the radial trachea occurs, for, as has been shown, the costal and subcostal are both absent.

It is, however, of great phylogenetic interest to find that in the tracheation of the aphids, the weak character of this same trachea (that is the one preceding vein R_1) is evident. In *Lachnus*, probably the most generalized genus in the family, this branch is scarcely to be distinguished from the secondary branches of the radial trachea and is emphasized chiefly from the fact that it is succeeded by a vein R_1 (fig. 1). And in all of the generalized genera it is characterized by a wavering and uncertain course. It is consistent with this general tendency to find that this is the tracheal branch which if it appears at all in the specialized Chermesinæ is so weakly indicated as to become indistinguishable from the secondary branches and loses its significance as it is not succeeded by a vein, vein R_1 being absent in the Chermesinæ.

The wings of the Chermesinæ are at a glance conspicuously of a different type from those of the more generalized aphids, and this difference in venation has heretofore been interpreted as due to the absence of media (the "third discoidal"). Especial attention is called, therefore, to figures 28 and 29. These are two drawings made of the same identical wing of *Chermes pinifoliæ*,—figure 28 drawn immediately after mounting when most of the tracheæ showed, and figure 29 drawn from the same mount 24 hours later when the tracheæ had cleared and become invisible and the veins are apparent instead. These drawings indicate the character of the difference between the *Chermes* venation and that of the more generalized genera. R_1 has disappeared and Rs, losing its characteristic curve, lies along the caudal margin of the stigma. Media, apparently to replace the position and function thus deserted by the radial sector, migrates forward to approximately the position which the "stigmal vein" or radial sector occupies in the generalized genera. This is an interpretation which could in no wise be settled except by appeal to the trachea-

* Comstock and Needham. Wings of Insects. pp. 245—251.

tion, and it is perhaps as pretty an illustration as can be found of the conclusive evidence which tracheation can sometimes bear in a doubtful case of venation.

The same condition is shown in *Chermes abietis* (figs. 24 and 25).

Although the radial trachea [1] as no main branches except R_1 and the sector, this trachea very frequently as is the case of the other tracheæ, bears a great number of secondary ramifications. These secondary branches are omitted in many of the drawings accompanying this study as they are the first to clear and become invisible,* and were frequently neglected when first attention was concentrated on other points. However, a glance at *Chermes abietis* (fig. 24) and *Lachnus strobi* (fig. 1) representing the genera at the extreme ends of the Aphididæ show the general condition of these radial ramifications which are further treated under the discussion of the subcosta (see page 108).

With an understanding of the tracheation, little explanation is required for the vein radius. Except for the *Chermesinæ*, the free part of R_1 forms the caudal boundary of the stigma and extends to the margin of the wing. The radial sector originates in the vicinity of the stigma and curves strongly to near the tip of the wing. The main stem of radius extends from the junction of these branches to the base of the wing in a line about parallel to the subcosta,—forming indeed a part of that strong main composite vein channel of the wing.

In Chermesinæ, radius is unbranched, as has been explained, and takes a straight course from the base of the wing to the extremity of the stigma. A double adjustment takes place here. Correlated with the loss of R_1, which in the more generalized genera bounds the stigma along its distal edge, is a straightening of the caudal margin of the stigma and a straightening of the course of the radial sector so that the radial sector runs along the edge of the broadened stigma in this type of wing (figs. 31 and 32).

MEDIA OF APHIDIDÆ.

For a correct interpretation of media an understanding of the tracheation is necessary. The freshly emerged wing of *Myzus cerasi* (fig. 3) gives a fairly typical tracheation for the more generalized wings. The medial trachea will here be seen, as is true for all the genera of Aphididæ, to be the second of the two main tracheæ to enter the wing from the body cavity. This trachea

* See discussion of preparation, page 103.

lies uniformly parallel to the radial trachea, usually separated from it by an appreciable distance, though often touching it, but not, except in rare instances,* really coalesced with the radial trachea. As we approach the wings most specialized by reduction of tracheæ, we come first to *Schizoneura* (fig. 22) and *Mindarus* (fig. 19) as examples of the medial trachea with but two branches, and then to such wings as those of *Pemphigus*, *Tetraneura*, *Hamamelistes* and *Chermes*, where media is unbranched. The migration of the medial trachea to approximately the position occupied by the radial sector which in turn migrates to meet the margin of the stigma, is characteristic of the Chermesinæ, and has just been discussed under the treatment of radius.

The tracheation of the adult wing, however, does not suffice to make perfectly evident the relation of media to cubitus. For instance, so far as has yet been demonstrated, what is here interpreted as M_3+_1 (fig. 22) might perhaps be understood as cubitus coalesced with media as Vickery† has explained it, or what is here interpreted as cubitus might be homologized as a branch of media as Handlirsch‡ has done. Fortunately the tracheation of the wing pad of the nymphs of certain species make this point entirely clear. Reference to the nymphal pad of *Schizoneura rileyi* (fig. 21) gives an unmistakale demonstration concerning the point at issue. Four main tracheæ are seen to be separate to the place of connection with the body trachea. These are the forerunners of radius, media, cubitus and the first anal vein. The two-branched media and the unbranched cubitus of *Schizoneura* are thus clearly seen to be preceded by distinct tracheæ separate to the base of the wing pad, and the relation of media to cubitus in the mature wing becomes at once apparent and the degree of basal coalescence evident.

After the foregoing discussion of the tracheation little remains which needs to be said concerning the vein media. For approximately one-half the length of radius media is coalesced with R+Sc.‖ and nearer the base of the wing similarly with the proxi-

* For discussion of coalescence and anastomosis of the tracheæ, see page 106.

† Vickery, '08, page 9. Figure 2.

‡ Handlirsch. Die Fossilen Insekten und die Phylogenie der Rezenten Formen. 1906–08. Taf. VIII, figures 9 and 10.

‖ "The figures show that in some cases what appears as a single vein is formed about two closely parallel tracheæ. This is shown in the case of the bases of the second and third principal tracheæ, counting from the costal margin of the wing, the radial and medial tracheæ. This illustrates a fact of frequent occurrence, that what appears to be a single vein may be formed by the coalescence of two primitive veins." Comstock–Needham, Wings of Insects, p. 48.

mal portions of cubitus and the first anal vein. The free part of media occupies about the center of the distal half of the wing. Its maximum number of branches is three, —M_1 and M_2 and M_3+_4 (fig. 8). The first step at reduction is in such wings as *Schizoneura* and *Mindarus* where M_1 and M_2 are coalesced, giving a two-branched media M_1+_2 and M_3+_4 (figs. 20 and 23). These two branches in turn are coalesced, resulting in the unbranched media $(M_1+_2+M_3+_4)$* in the wings having the most reduced venation.

The connection between the free parts of media, cubitus and the anal vein and the composite main vein is frequently broken, on account, probably, of the strong ridge in the wing caused by this vein. This part of media being in the central portion of the wing is not, apparently, so necessary to the strength of the wing as the veins on either side, and starting from the broken basal connection media is found in various degrees of atrophy, in some species one-third to one-half of the base of the free part of media being lacking (fig. 17).

CUBITUS OF APHIDIDÆ.

Cubitus is present in all the genera of Aphididæ and in all of them unbranched.

The tracheation of the freshly emerged wing and of the wing pad explains cubitus and its relation to the other veins.

Attention is called to figure 22, *Schizoneura rileyi*, which gives a fair illustration of the cubital trachea. Its basal portion is coalesced with those of the medial and anal tracheæ. In most wings the free portion of the cubital trachea originates about midway between the medial and first anal tracheæ. In some instances however, the cubital trachea runs along parallel with the medial trachea for some little distance. Figure 9, a mount of a newly emerged hind wing of *Macrosiphum pisi*, is an unusual instance even for the species in question, where the cubital trachea runs parallel with the medial to almost the base of the wing before it becomes coalesced. On the other hand, in the wing of *Hamamelistes spinosus* (fig. 15) a greater degree of coalescence has taken place and the cubital and first anal tracheæ branch from the medial on a common stem, and proceed some little distance before separating.

* See page 106 for a discussion of the course of a vein.

The tracheation of the wing itself, however, is not sufficient to define cubitus beyond question, and numerous mounts of nymphal wing-pads were examined with this end in view. Perhaps the most satisfactory is that of *Schizoneura rileyi* (fig. 21) in which a portion of the body trachea is seen with four main wing tracheæ, the fore-runners of radius, media, cubitus and the first anal vein.

Cubitus is here clearly shown in its relation to media and the first anal and the peculiar complications of the venation of the adult wing are thus explanable as coalescences with media on the one hand or the first anal on the other. *Schizoneura rileyi* was the only species in which the writer has succeeded in getting the connection of these four nymphal wing tracheæ with the body trachea, but mounts of *Callipterus ulmifolii* showed four main tracheæ distinct to the base of the pad, as did also mounts of *Aphis* sp. In the last nymphal stage there is a tendency, in some species at least, for the basal portions of the medial, cubital and first anal tracheæ to become coalesced, giving the two main tracheal stems of the mature wing. This is shown in a wing pad of the last nymphal stage of *Mindarus* (fig. 18) where the four main tracheæ are distinct nearly to the base of the pad where three of them become coalesced before reaching the body trachea.

The vein cubitus so closely follows the cubital trachea that a further discussion concerning it is not necessary.

THE ANALS OF APHIDIDÆ.

The same mounts which explain cubitus show just as clearly the first anal and its relation to the other veins. We have then the unmistakable homologies of four of the wing veins of Aphididæ traced in the courses of the tracheæ of the freshly emerged wings and the wing pads of the nymphs: the "first discoidal" being the first anal, the "second discoidal" being the cubitus, the "third discoidal" or "cubital vein" being the media and the "fourth discoidal" or "stigmal vein" being the radial sector.

This seems enough to ask of the tracheæ of a highly specialized wing, but they do tell even more. They give constantly the second anal which appears in the freshly emerged wings for all the genera studied by the writer, as a delicately marked and fairly regularly placed trachea. No vein is formed about this trachea so that it has no other significance for the venation than to help determine that the anal vein here homologized as the first anal

has not been so homologized without tracheal evidence that it is not the second or third anal, —a statement further elucidated by the appearance of a third anal trachea in many freshly emerged wings. Figures 1 and 3 and others give the second anal trachea in its characteristic position, and figures 2, 4, 6 and others give a few of many mounts showing the third anal trachea also. These last anal tracheæ are among the first of the tracheæ to become invisible, so that in drawings made with other points in view, they are frequently not indicated, as they had cleared before the other points at issue had been finished.

The presence of the second and third anal tracheæ in the nymphal wing pad has not been established in those species of aphids in which the nymphs were studied. What the history of these tracheæ is, then, previous to their appearance in the recently emerged wing is not yet ascertained.

THE HIND WING OF APHIDIDÆ.

The hind wing of *Chaitophorus populicola* (fig. 7) will serve as an illustration of the tracheation of the hind wings of the more generalized genera. In figure 9 of the *Macrosiphum pisi* the four tracheæ are distinct to very near the base of the wing. Usually a greater degree of coalescence has taken place even for this species.

By referring this wing to the front wing of *Chermes* (Plate XIX) we can readily homologize the unbranched radial trachea, the simple medial trachea, the cubital trachea and the first anal. Like the second anal of the fore wing, the first anal of the hind wing appears only as a trachea and is not followed by a vein.

The same tracheæ occur in the other more generalized genera, and also in *Pemphigus* (fig. 13) where the front wing is specialized by the reduction of veins in media. When we reach *Chermes* (fig. 30), however, we find, in spite of the wealth of secondary tracheæ, only the radial and medial tracheæ marking the courses of succeeding veins and these are coalesced at the base.

The venation of the hind wing is, then, homologized, as follows: the marginal costa and the very faint subcosta, both of which, due to the lack of mechanical necessity found in the front wing, are not well developed; the radius represented by the radial sector only; the media always simple; and in the more generalized genera, cubitus. The venation of *Tetraneura* (fig. 17) is of interest. The front wing has the venation of *Pemphigus* and

the hind wing lacks the cubitus and is, therefore, a step in the direction of *Chermes*.

Although we find the same veins in the hind wings of *Macrosiphum solanifolii* (fig. 8) and *Pemphigus acerifolia* (fig. 13) for instance, these two wings appear different on account of the difference of position of the veins. The radial sector takes the same course in both wings, but the free part of cubitus originates much nearer the base of the wing in *Macrosiphum* while usually in *Pemphigus* cubitus is coalesced with media to the point where media branches off from the course of radius. This peculiarity is correlated with a similar manifestation in the front wing of *Pemphigus* and is doubtless due to the long narrow wings of this genus.

In *Chermes* (figs. 30 and 31) as was stated in the discussion of the tracheation, only veins radial sector and media are represented, and the hind wing of *Phylloxera* (fig. 32) has retained only the radial sector.

PSYLLIDÆ.

The tracheation of the psyllid wing is instructive both because it throws light upon the interpretation of the venation of the psyllid wing and because it bears strong additional evidence in support of the conclusions arrived at for the aphid wings.

Fig. 33 gives the tracheation of the fore-wing pad of the nymph of *Psylla floccosa* Patch. It will be seen by reference to this that there is no coalescence for these tracheæ at this stage. They all branch separately from the body trachea. There are seven tracheæ: the costal; a short trachea lying at the very margin of the wing pad; the unbranched subcostal extending in a line about parallel to the costal margin of the pad and lying very close to the costal trachea at the base; the radial, terminating in two long branches, the forerunners of R_1 and Rs; the two-branched medial; the typical two-branched cubital; and two anal tracheæ.

This comes surprisingly close, for a wing so highly specialized, to the hypothetical type of Comstock–Needham.

The newly emerged wing shows a decided change in the appearance of the tracheæ, but the change is due to basal coalescence instead of any radical change in the number or branching of the tracheæ.

The tracheation of the freshly emerged wing of *Psylla floccosa* (Fig. 34) shows the degree of this change. The costal trachea has

disappeared as is frequently the case.* The subcostal and second anal tracheæ have migrated to very near their respective margins of the wing, but are both distinct. The first anal, a slender but distinct trachea, follows the course of the claval suture. The proximal portions of the radial, medial and cubital tracheæ are coalesced into a common stem at the basal fourth of the wing. This main stem divides into two tracheæ, the radial and the common stem of the medial and cubital. The latter soon separates again into the free portions of the medial and cubital tracheæ.

There is a greater degree of coalescence in the tracheation of this psyllid wing than occurs in that of the aphid wing as the radial trachea is always (except in very unusual variations as cited, page 107) separate to the base of the freshly emerged aphid wing.

The venation of *Psylla floccosa* (fig. 36) coincides with the tracheation of the freshly emerged wing very closely. Subcosta strengthens with the costa the cephalic margin of the wing. The second anal in a similar way reinforces the anal margin at the base. The first anal is so delicately traced along the claval suture that it cannot function as a strengthening rod in the wing as do the other veins. Indeed it has frequently been considered not a true vein.

Radius, media, and cubitus share about equally the burden of strengthening the wing. They are coalesced as a common main stem at the base. The relation of media and cubitus is similar to that of the same veins in the wing of the aphids and this typical two branched cubitus bears further evidence of the correctness of the interpretation of cubitus in the aphid wing.

R_1 responds to the mechanical necessity for strengthening the front of the wing. It is the only vein present in this region and upon it falls the burden as well as the approximate position usually assumed by the subcosta in many insect wings. Rs is a strong vein and reaches the margin near the apex of the wing.

The tracheation of the freshly emerged hind wing of *Psylla floccosa* resembles that of the front wing closely. (Fig. 35). The subcostal and second anal tracheæ lie near their respective wing margins, as in the front wing. The first anal trachea occu-

* "Its trachea is often atrophied, probably owing to the disadvantageous position of its base in relation to air supply, as we have hitherto indicated." Comstock-Needham: Wings of Insects, page 858.

pies the same position as in the front wing. Similarly there is a common stem of the radial, medial and cubital tracheæ. The medial trachea, however, is unbranched, and the tracheal branch preceding R_1 is wanting.

The loss of R_1 is significant. This vein is one of the least stable of the Hemipterous wing veins. Its complete absence has been established for the Cicada and a Coreid.* In the front wing of the aphids R_1 was seen to be preceded by a wavering trachea in all the subfamilies except the Chermesinæ where the vein R_1 is altogether lacking. In the hind wing of none of the aphids does either the vein R_1 occur, or the corresponding trachea.

In the front wing of the psyllid and *Heuralius* alone for this group is R_1 a strong vein and here it is evidently the response to the mechanical necessity not otherwise provided for. Subcosta is wanting and, as the only vein present in this portion of the wing, the burden of support falls upon the radius.

It is exceedingly interesting to find the condition of R_1 as predicted for the Hemiptera† on the basis of the Cicada and Coreid, fulfilled in this group of highly specialized Homoptera.

It is interesting, too, to find the same veins, vein for vein, appear in the wing of the psyllid that we have in the wing of the aphid—the most striking difference is a very slight one,—the cubitus branched in the psyllid and unbranched in the aphid. There is experienced no difficulty, as has been seen, in homologizing either the aphid or the psyllid veins independently of each other but the fact that in doing so the conclusions arrived at with each support and bring additional evidence for the other should in no wise be disregarded.

The fact that the costal margin of the psyllid wing is strengthened in one of two distinct ways (1) by a stigma and (2) by R_1, is very well brought out in the five psyllids which have been selected to represent the venation of this family. Of these *Euphalerus nidifex* Schwarz‡ (fig. 38) would seem to be the most generalized type so far as the radial region is concerned, R_1 in this wing extending to near the tip of the wing as the trachea preceding R_1 does in the nymphal wing pad of *Psylla floccosa* (fig. 33). In *Pachy-*

* Comstock and Needham: Wings of Insects. Page 245.

† Comstock and Needham: Wings of Insects. Page 245.

‡ For an opportunity to study and figure the wings of E. nidifex and A. mori, the writer is indebted to Dr. L. O. Howard, who kindly loaned specimens of these species for this purpose.

psylla c. mamma Riley (fig. 39) the tip of R_1 has migrated slightly toward the middle of the costal margin. In both these wings the space from the base of the wing to the tip of R_1 is evidently too long to bear the strain of flight without further strengthening. This needed reinforcement occurs in the presence of a more or less pronounced stigma the proximal edge of which is margined by a ridge which is in some species so clearly defined as to be frequently figured as a vein.

As the tip of R_1 approaches the middle of the costal margin as in *Anomoneura mori* Schwarz (fig. 40) and even more in *Psylla floccosa* (fig. 36) the need of the stigma is removed as R_1 strengthens this portion of the wing margin.

The wing of *Trioza* (fig. 37) shows an extreme case of the migration of R_1, this vein being here scarcely longer than the stigmal ridge in *Pachypsylla* and in about the same position. Correlated with this condition are other striking departures from the more generalized psyllid wing, perhaps the most conspicuous being the origin of the free parts of media and cubitus at approximately the same point as the origin of the free part of radius,—the common stem M + Cu present in most psyllids being lacking in *Trioza*.

The wing of *A. mori* is in one respect most unusual for the family, and that is in the branching of the radial sector. This is the only instance in the four families discussed in this paper where the radial sector is branched, and it throws additional evidence on the interpretation of this vein as the sector. It should be stated in connection with the discussion of figure 40, that the venation here shown may possibly be not normal for this species. The writer had access to but a single specimen and in this the radial sector of the wing on one side bore five branches as figured while the radial sector of the other side was six branched.

The purpose of this study in wing tracheation has had the vein homologies as a goal and is not intended to enter into systematic discussions. However, since the systematists of the Psyllidæ build their tables largely upon the basis of the wing veins,* it is apparent that it would be more satisfactory to apply

* Löw. Verh. g–b. Wien XXVIII.
Maskell: Transactions of the N. Z. Institute Vol. XXII, 1889, page 158.
Frogatt: Australian Insects.
Kuwayama: Trans. of the Sapporo Nat. Hist. Soc. 1907–08.

a terminology which has the same significance for not only the closely related families of Aphididæ, Aleurodidæ, and Coccidæ, but the other insect orders as well.

For instance it would certainly seem more convenient to say "M+Cu is longer than the stem of R" than to resort to the more tortuous statement of Maskell*: "the stalk of the lower branch (cubitus) of the furcation of the primary vein is longer than the stalk of the upper branch (subcosta)."

At present the veins in the figures of the psyllid wings are indicated by arbitrary letters or figures with no necessary relation to symbols used by the same author for any other psyllid wing or to those of any other author for the same wing. This haphazard arrangement of lettering or numbering the figures of psyllid wings increases the confusion caused by the fact that the veins themselves are cumbered with such a system of nomenclature as the following:

"Stalk of cubitus, lower branch of cubitus, lower fork of lower branch of cubitus, upper fork of lower branch of cubitus," etc.

But by the use of a uniform system of wing terminology the abbreviation of the names of the veins become the natural and inevitable symbols to use for lettering the figures of the wings, and no confusion arises in associating Rs of the figure, for instance, with the radial-sector of the text.

The relative simplicity, ease of abbreviation and uniformity of such a system of terminology is recommendation enough aside from the homological significance it bears.†

As is stated in the discussion of Redtenbacher's homologies (see page 125) except for his interpretation of the alternate concave and convex veins his terms for the psyllid veins are in the main those applied in this present paper upon the basis of the tracheation.

ALEURODIDÆ.

Four fine but distinct tracheæ are present in the freshly emerged wing of Aleurodes *sp.*, the costal, subcostal, radial and cubital tracheæ (fig. 44). All of these are uncoalesced to the

* Maskell: Trans of the N. Z. Institute, Vol. XXII, 1899, page 158.

† The Comstock Needham system of terminology has been adopted by Handlirsch in all his recent papers dealing with venation of fossil insects and in his extended monograph of the fossil insects of the world. (Die Fossillen Insekten und die Phylogenie der Rezenten Formen 1906–1908). It has been with interest that the writer has noticed the application of this system of nomenclature to the group of insects with which this present paper deals, especially as the basis for his conclusion was a study of the treacheation of the wings.

base of the wing. The medial trachea is suggested merely by a very faint and delicate but constantly appearing tracing in the wing.

As in the wings of Aphididæ and Psyllidæ the radial trachea in Aleurodidæ is branched, being represented by the branches corresponding to R_1 and Rs. And as in the hind wing of all aphids and the front wing of the Chermesinæ, and the hind wing of psyllids, the *vein* radius in Aleurodes is unbranched, R_1 being lacking. The formation of the vein radius in Aleurodes is of exceeding interest. It follows the course of the radial trachea to the branching of the trachea and then proceeds along the radial sector. R_1 in the mature wing is lost and its position, if indicated at all, is suggested by the most delicate "shadowing" in the wing tissue. As has been previously stated,* the "complete absence of vein R_1" was predicted as characteristic of the Hemiptera on the basis of the two widely separated insects,—the Cicada and a Coreid, and the phylogenetic significance of the added testimony of the weakness of this vein and the trachea that precedes it, in the remote and highly specialized group of Homoptera here under consideration seems to the highest degree interesting.

The tracheation of *Aleurodicus* I have not had an opportunity to study. On the basis of figures of the mature wing (not a safe basis for this group by any means, as has been shown), however, the additional vein found there can only be interpreted as R_1. Its prominence is to be accounted for here doubtless, as in the case of its prominence in the forewing of the psyllid, by the rounded shape of the wing which results in a large wing expanse not otherwise strengthened. In response to mechanical necessity this vein, weak or absent when not needed, becomes more strongly developed.

The second vein of the wing of *Aleurodes* is cubitus as will be seen by comparing figures 44 and 45 where the second vein is shown to follow the course of the cubital trachea.

The hind wing of Aleurodes (fig. 40) has but one trachea and one vein, —the radial sector it seems inevitable to conclude.

COCCIDÆ.

Before examining wings of freshly emerged male coccids it seemed possible only to echo the sentiment of Redtenbacher,—"*Cocciden konnte ich nicht untersuchen.*"† Imagine the surprise,

* See Page 119.

† Vergleichende Studien uber das Flugelgeader der Insekten. Page 188.

then, which was caused when mount after mount of *Dactylopius* sp. on cactus showed five very delicate but perfectly distinct tracheæ. See Figure 42.

Four of these tracheæ are simple and uncoalesced to the base of the wing. They are arranged in two groups, the base of the subcostal, radial and medial tracheæ lying close together and the cubital and first anal tracheæ forming the other group at a little distance from the first.

The subcostal and radial tracheæ are both very wavy and as they lie close together, they cross and recross, often for the greater part of their length.

The medial trachea takes a median course. This consists of two interwoven branches, pursuing a common course.

The tracheæ in the wing of this coccid remain distinct until after the veins begin to form so that the relation of the two is at once discerned. One vein follows the general trail of the subcostal and radial tracheæ. This vein very evidently represents radius.

The second vein follows the base of the first tracheal group to about the point where the medial tracheal separates from the subcostal and radial. The vein here takes a direct line for the middle of the caudal margin of the wing. For slightly less than one-third the length of this vein it frequently joins the path of the cubital trachea. This corresponds most closely with media.

Besides these two main veins a short spur representing the subcosta is present.

In a wing so highly specialized as the coccid wing it is not improbable that the tracheation has lost its value as a basis for the venation. Certainly in the species studied there seems no necessary connection between the tracheæ and the veins which are found later.

In *Pseudococcus citri* the tracheation was exceedingly difficult to trace. The same veins occur in this species (fig. 41) as in the preceding (fig 43).

In many species of Coccids there are shadowed portions of the wings. It is due to this fact that we find the coccids sometimes figured with apparently four long veins, alternately dark and light, as for instance, in Westwood.*

* Westwood, J. O. Arcana Entomologica. Vol. I, Plate 6.

HISTORICAL DISCUSSION.*

As is the case with other groups of insects the names applied to the wing veins of aphids were given in the first place without homological reference to the veins of other insects. That is, we have an arbitrary system which has no significance outside the family of Aphididae. Recently several papers have appeared which rename the wing veins with this aim in view, but as the true homologies of the wing veins themselves have not heretofore been established, certain mistakes in applying the Comstock-Needham nomenclature have, of necessity, arisen. These papers will be discussed in turn. First, however, it would seem of interest to review the earlier terminology.

For convenience in this discussion attention is called to Fig. 8, in which the names are used as based upon the homologies revealed in the study of the tracheation of the wings as recorded in this paper.

The following table will show the relation of the Comstock-Needham terminology to the terminology previously in use for the wing veins of aphids:

After Buckton	*Current terminology*	*Comstock-Needham*
	Fore Wing	(See fig. 8)
Costal Nervure	Costal	Costa (C.)
Cubitus or post-costal nervure	Subcostal vein	Subcosta (Sc) Radius$_1$ (R_1) (together with basal portions of the remaining wing veins).
Stigmatic	Stigmal vein	Radial sector (Rs)
First furcal	First branch	Media (M_1)
Second furcal	Second branch	Media (M_2)
Cubital nervure	Third discoidal or cubital	Media (M) Media $_3+_4$ (M_3+_4)
Second oblique	Second discoidal	Cubitus (Cu)
First oblique	First discoidal	First Anal (1st A.)
	Hind Wing.	
Cubitus or post costal nervure	Subcostal vein	Radial sector (Rs).
Second oblique	Second discoidal	Media (M.)
First oblique	First discoidal	Cubitus (Cu.)

* For careful general historical discussion of studies of wing-venation see MacGillivrary, A. D. ('06). Wings of the Tenthredinoidea. PP. 570–574.

The interpretation of the so-called subcostal has been* that it is a single heavy vein spreading at the distal portion into the stigma. That this interpretation is incorrect the foregoing discussion on the tracheation has made clear. It is really a composite structure bordered along the cephalic margin by the subcostal vein and containing the radius and the coalesced proximal portions of the remaining wing veins.

It will be seen by reference to the accompanying table that the first, second and third discoidals are respectively the 1st Anal, Cubitus and Media. The second anal not persisting in the adult wing (that is, it is represented only by a constantly appearing trachea which soon clears) is not shown in any published figures of aphid wings.

In the hind wings the first and second discoidals are respectively (fig. 8) the cubitus and media, and the so-called subcostal vein is the radial sector.

Redtenbacher† gives homologies of the wing veins of aphids and psyllids, which except for his interpretation of alternate convex and concave veins, come pretty close to the conclusions arrived at from the study of the tracheation. Except for Sc and vein VI in the forewing and that Sc is not accounted for in the hind wing his psyllid wings are correct. His difficulties with the aphid wings could not be settled without reference to the tracheation.

Handlirsch‡ gives the only figure of wing tracheæ for psyllids or aphids published previous to this present paper. His interpretation of the tracheæ for the wing pad of the psyllid nymph is practically the same as that given in this paper. With the freshly emerged wing of *Schizoneura lanigera*, however, three mistakes occur. The line which he indicates as the subcostal trachea does not occur as a trachea but as a well defined fold of the subcostal vein. (See page 108). The unbranched trachea which he considers M is really Cu. and his Cu. is one of the anals. The question in regard to M. and Cu. however could only be settled by the testimony of the tracheation of the wing pad. (See page 113 and fig. 21).

* Oestlund, O. W. Aphididae of Minnesota, p. 4. 1887.
Comstock, J. H. Introduction to Entomology, pp. 158–159. 1888.

† Redtenbacher, Josef. Ann. k. k. Naturh. Hofmus., I. 1886.

‡ Handlirsch, Anton. Die Fossilen Insekten und die Phylogenie der Rezenten Formen. 1906–08.

Handlirsch homologizes the veins of the Phytophthires which he figures and also names what tracheæ he figures.

In Woodworth's discussion of the wing veins of Phytophthires* the veins of these insects are homologized to the extent that the statement is made that the front wing of Aleurodidæ is the same in its maximum condition of venation as the maximum of the hind wings of Aphidæ, and the hind wings the same as the minimum of Aphidæ, and that the venation of the front wing of Coccidæ is the same as the minimum of the front wing of Aleurodidæ. This author figures wings of all the Phytophthires he discusses but as the wing veins are not labeled and it is not apparent from the text which of the "independents" he interprets the media and the cubitus to be either with the psyllids or aphids it is not possible to homologize them from his figures. The meaning of his statement that in only the Psyllidæ is the venation extensive enough to show clearly their affinity to the higher Homoptera is not apparent, as his maximum number of veins for the aphids according to his figures exceeds the maximum for the psyllids; and the number when the minimum is taken is the same for both wings except for one extra branch for the psyllids. Exception, moreover should be taken to his diagram of the venation of the Aphididæ, for the "additional independent and the cross vein at the tip" which he states are very rarely present, are never present in fact in the normal venation of any species of aphid. And if abnormal or freak veins are to be included in the venation of aphid wings there would be no reason to stop at these two, for cubitus might be branched, any of the branches of media have an extra fork and "cross-veins" might be almost indiscriminately located as between cubitus and the first anal.

In a very convenient classification of some of the external characters of Aphididæ Mr. Vickery† attempts a homology of the wing veins of aphids with those of other insects, stating that the names he gives, based upon Comstock's system, were decided upon from a study of other reduced wings such as Psocus, and from a study of the abnormal venations found so frequently in plant-lice. Mr. Vickery's homologies are based upon the comparison of mature wings and the misinterpretations which have

* Woodworth, C. W. ('06). The Wing Veins of Insects. pp. 124–125.

† Vickery, R. A. ('08). A Comparative Study of the External Anatomy of Plant-lice.

arisen are readily explained by this fact. Perhaps in no other family could be found a clearer demonstration of the value of the study of the tracheation in this connection.

SUMMARY.

The introductory discussion outlines the reasons for undertaking this study of wing vein homologies, states the conditions under which the study has taken place, and mentions some of the difficulties involved in the manipulation of this sort of material.

Attention is called to the coalescence of tracheæ both the normal occurrence and some unusual instances.

All the veins present in the four families discussed are homologized, each being taken up for detailed consideration and the tracheal basis for the homologies being carefully stated.

The historical discussion includes a notice of all such published work as has any direct bearing upon this present paper.

All the main features of venation or tracheation discussed are illustrated by the accompanying figures.

BIBLIOGRAPHY.

Buckton, G. B. Monograph of British Aphides.
Comstock, J. H. Introduction to Entomology.
Comstock, J. H. Manual.
Comstock, J. H. and Needham, J. G. Wings of Insects.
Froggatt, W. W. Australian Insects.
Handlirsch, A. Die Fossilen Insekten und die Phylogenie der Rezenten Formen 1906–1908.
Kuwayama, I von S. Die Psylliden Japans. Trans. of Sappro Natural Hist. Society. 1907–08.
Loew, F. Gen. Aphalara et Rhenocola. 1882. (Zoologisch Botanische Wien Taf. XI.)
Loew, F. Mittheilungen über Psylloden. Verh. z.–b. Wien XXIX, pp. 549–598. pl. XV. 1879.
Loew, F. Psylloden. Taf. IX. (1878.) Verh. z.–b. Wien XXVIII.
Loew, F. Revision der palaarktischen Psylloden in Hinsicht auf Systematik und Synonymie. Verh. z.–b. Wien XXXII, pp. 225–254. 1882.
Loew, F. Zur Biologie und Charakteristik der Psylloden nebst Beschreibung zweier neuer Species der Gattung Psylla. Verh. z.–b. Wien, XXVI, pp. 187–216. pls. 1 and 2, 1876.
Loew, F. Zur Systematik der Psylloden. Verh. z. b. Wien, XXVIII, pp. 586–610, pl. IX. (Figures of the neuration of 11 genera) 1878.
MacGillivray, A. D. A Study of the Wings of the Tenthredinoidea. Proceedings of the Nat. Museum. Vol. XXIX. 1906.
Oestlund, O. W. Aphididæ of Minnesota. 1887.
Packard, A. S. 5th Report Ent. Commission.
Redtenbacher, J. Flugelgeader der Insecten. Ann. k. k. Naturh. Hofmus. I. 1886.
Riley, C. V. Notes on N. A. Psyllidæ. Biological Society of Washington, 1883.
Sanborn, C. E. Kansas Aphididæ.
Schwarz, E. A. Entomological Soc. of Washington. 1902–04. Notes on North American Psyllidæ.
Scott, J. Monograph of the British species belonging to the Hemiptera Homoptera, family Psyllidæ; Tr. E. Soc. 1876. pp. 525–569, pls. VIII and IX.

Scott, J. On certain Genera and Species of the Group of Psyllidæ in the collection of the British Museum. 1882. Trans. Ent. Soc. London. 1882. pp. 449–473. Plates XVIII, XIX.
Scudder, S. H. Fossil Insects.
Vickery, R. A. A Comparative Study of the External Anatomy of Plant Lice. 1908.
Woodworth, C. W. The Wing Veins of Insects. 1906.

EXPLANATION OF PLATES.

The figures submitted have been selected from numerous ones prepared in the progress of this study. In their preparation two methods were employed. The figures showing tracheation are from camera lucida sketches verified or corrected by examination of each significant point through a high power lens,—oil emersion when necessary. The figures giving venation (except Fig. 29) are ink tracings of photographs,—the blue prints which were used being bleached after the drawings were made in order that black and white figures uniform with the camera lucida sketches might be secured.

PLATE XVI.

FIG. 1. *Lachnus strobi* (Fitch). Tracheation of wing of newly emerged aphid. See page 111.

FIG. 2. *Melanoxanthus* sp. Wing of newly emerged individual showing an unusual case of coalescence of tracheæ, See page 107.

FIG. 3. *Myzus cerasi* (Fab.) Tracheation of wing of newly emerged aphid. See page 110.

FIG. 4. *Aphis* species. Tracheation of wing of newly emerged aphid showing connection with the body trachea. The region of the costal vein and also the main vein channel of the wing indicated here. See page 108.

FIG. 5. *Callipterus ulmifolii* Monell. Tracheation of wing of newly emerged aphid.

FIG. 6. *Chaitophorus nigræ* Oestlund. Tracheation of wing of newly emerged aphid. See page 116.

FIG. 7. *Chaitophorus populicola* Thos. Tracheation of hind wing of newly emerged aphid. Typical, showing connection with body trachea. See page 116.

FIG. 8. *Macrosiphum solanifolii* Ashmead. Venation of both wings.

FIG. 9. *Macrosiphum pisi*. Tracheation of hind wing of newly emerged aphid. Very exceptional. See page 116.

PLATE XVII.

FIG. 10. *Microparsus variabilis* Patch. Venation of both wings. Venation of this species very unstable. The type figured is a common one.

FIG. 11. *Toxoptera graminum* Rond. Venation of both wings.

FIG. 12 and 13. *Pemphigus acerifolii* Riley. Tracheation of fore and hind wings of newly emerged aphid. See pages 109 and 117.

FIG. 14. *Pemphigus venafuscus* Patch. Venation of both wings.

FIG. 15. *Hamamelistes spinosus* Shimer. Tracheation of wing of newly emerged aphid. See page 114.

FIG. 16. *Hamamelistes spinosus* Shimer. Venation of both wings.

FIG. 17. *Tetraneura* sp. Venation of both wings.

PLATE XVIII.

FIG. 18. *Mindarus* (*abietinus* Koch ?). Tracheation of wing pad of nymph. See page 115.

FIG. 19. *Mindarus* (*abietinus* Koch ?). Tracheation of freshly emerged wing.

FIG. 20. *Mindarus* (*abietinus* Koch ?). Venation of both wings. See page 114.

FIG. 21. *Schizoneura rileyi* Thomas. Tracheation of wing pad of nymph. See page 114.

FIG. 22. *Schizoneura rileyi* Thomas. Tracheation of freshly emerged wing. See page 114.

FIG. 23. *Schizoneura americana* Riley. Venation of both wings.

PLATE XIX.

FIG. 24. *Chermes abietis* (Linn.). Tracheation. Note how the branches of the radial trachea weave along the margin. See page 110.

FIG. 25. *Chermes abietis* (Linn.). Tracheation. An extraordinary case in which the first anal trachea is distinct to the base of the wing. See page 107.

FIG. 26. *Chermes pinifoliæ* Fitch. Tracheation. An unusual case of coalescence. See page 107.

FIG. 27. *Chermes pinifoliæ* Fitch. Tracheation. An unusual case of coalescence. See page 107.

FIG. 28 and FIG. 29. *Chermes pinifoliæ* Fitch. Two camera lucida drawings of the same identical wing. Fig. 28 shows the tracheation of the freshly emerged wing, and Fig. 29 shows the course of the veins Rs, M, Cu and 1st A, twenty-four hours after Fig. 28 was drawn and after the trachea had all become invisible. See page 111.

FIG. 30. *Chermes pinifoliæ* Fitch. Normal tracheation of hind wing. See page 116.

FIG. 31. *Chermes*. Venation of both wings.

PLATE XX.

FIG. 32. *Phylloxera* sp. Venation of both wings.

FIG. 33. *Psylla floccosa* Patch. Tracheation of wing pad of nymph.

FIG. 34 and FIG. 35. *Psylla floccosa* Patch. Tracheation of freshly emerged fore and hind wings.

FIG. 36. *Psylla floccosa* Patch. Venation of fore wing.

FIG. 37. *Trioza* species. Venation of both wings.

PLATE XXI.

FIG. 38. *Euphalerus nidifex* Schwarz. Venation of forewing. See page 119.

FIG. 39. *Pachypsylla celtidis* Riley. Venation of both wings. See page 119.

FIG. 40. *Anomoneura mori* Schwarz. Venation of forewing. See page 120.

FIG. 41. *Pseudococcus citri*. Venation. See page 123.

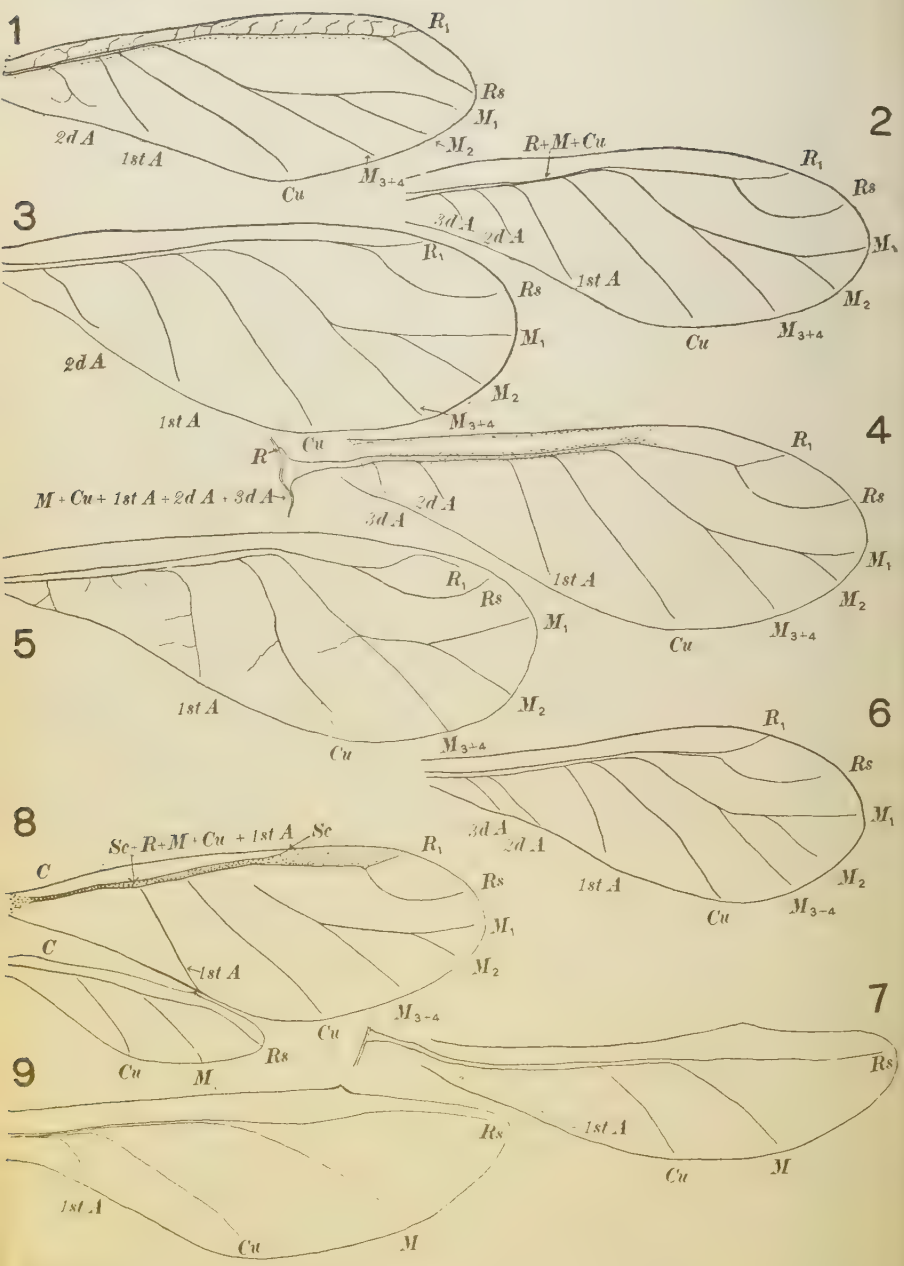
FIG. 42. *Dactylopius* species. Tracheation of freshly emerged wing. See page 123.

FIG. 43. *Dactylopius* species. Venation. See page 123.

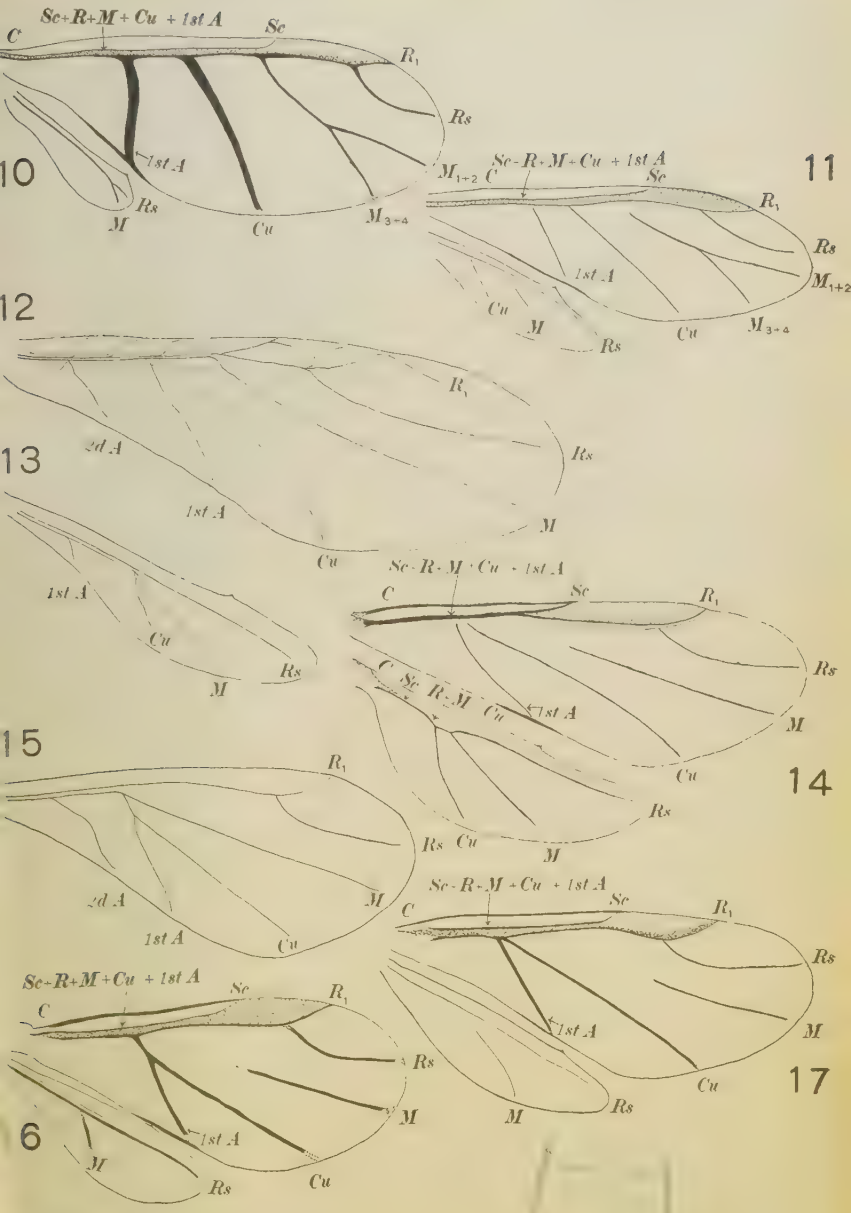
FIG. 44. *Aleurodes* sp. Tracheation of freshly emerged fore wing. See page 122.

FIG. 45. *Aleurodes* sp. Venation of forewing. See page 122.

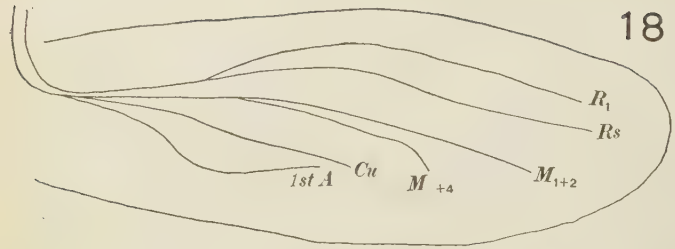
FIG. 46. *Aleurodes* sp. Tracheation of hind wing. (Venation is identical with this). See page 122.

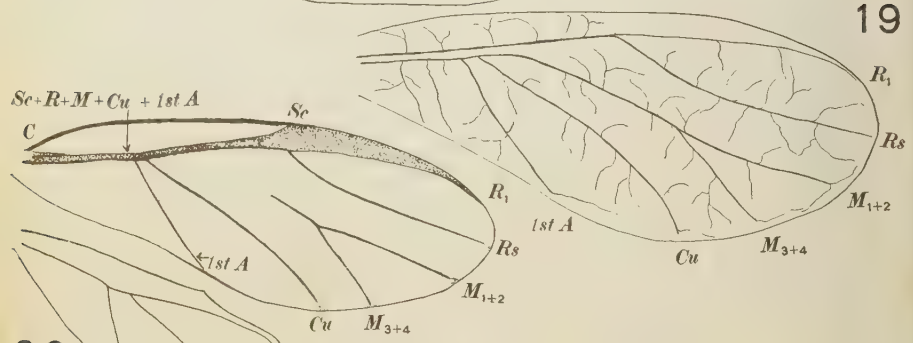


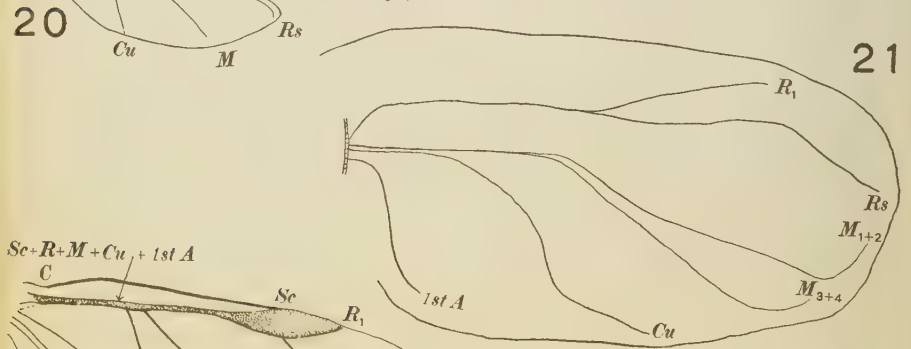
Edith M. Patch.

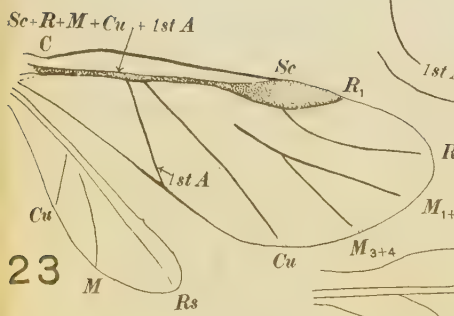


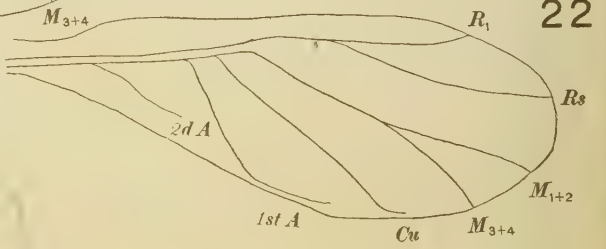
Edith M. Patch.



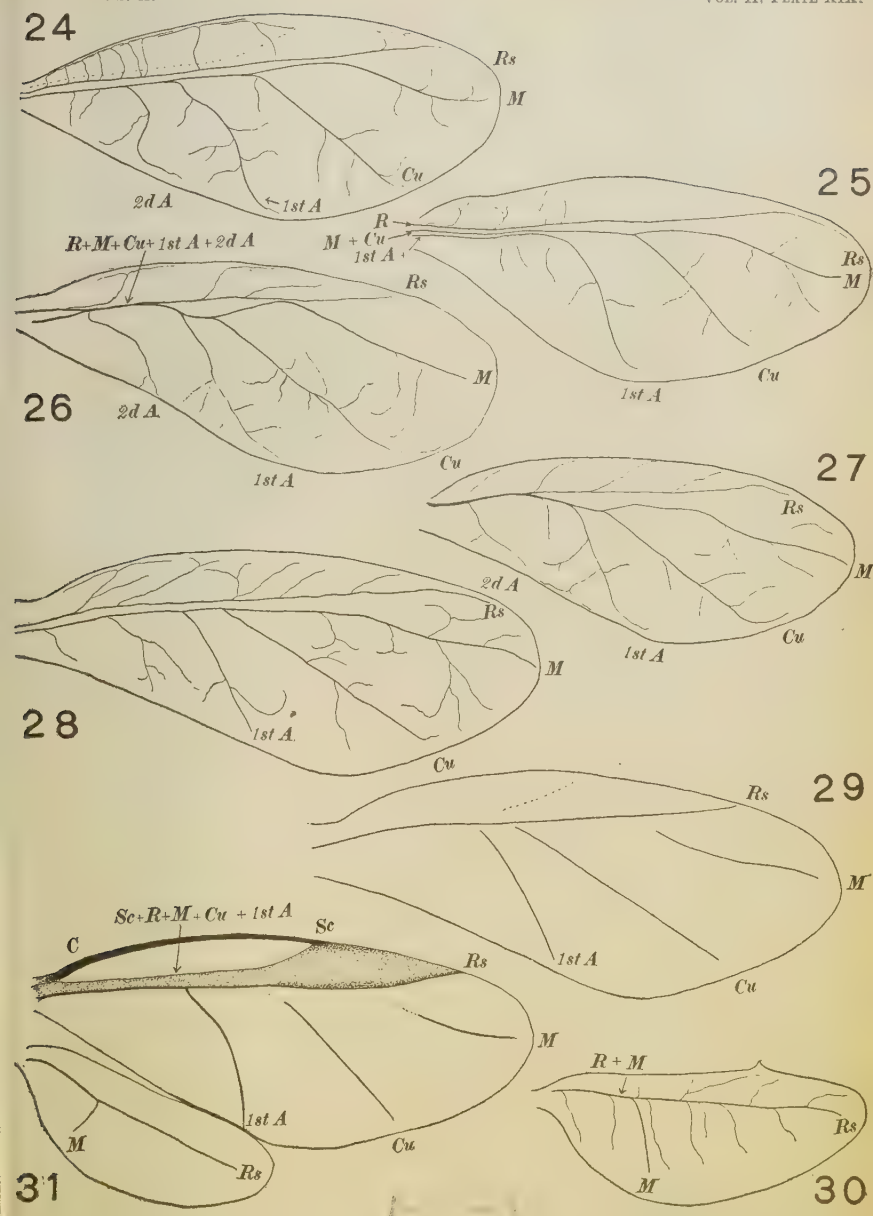




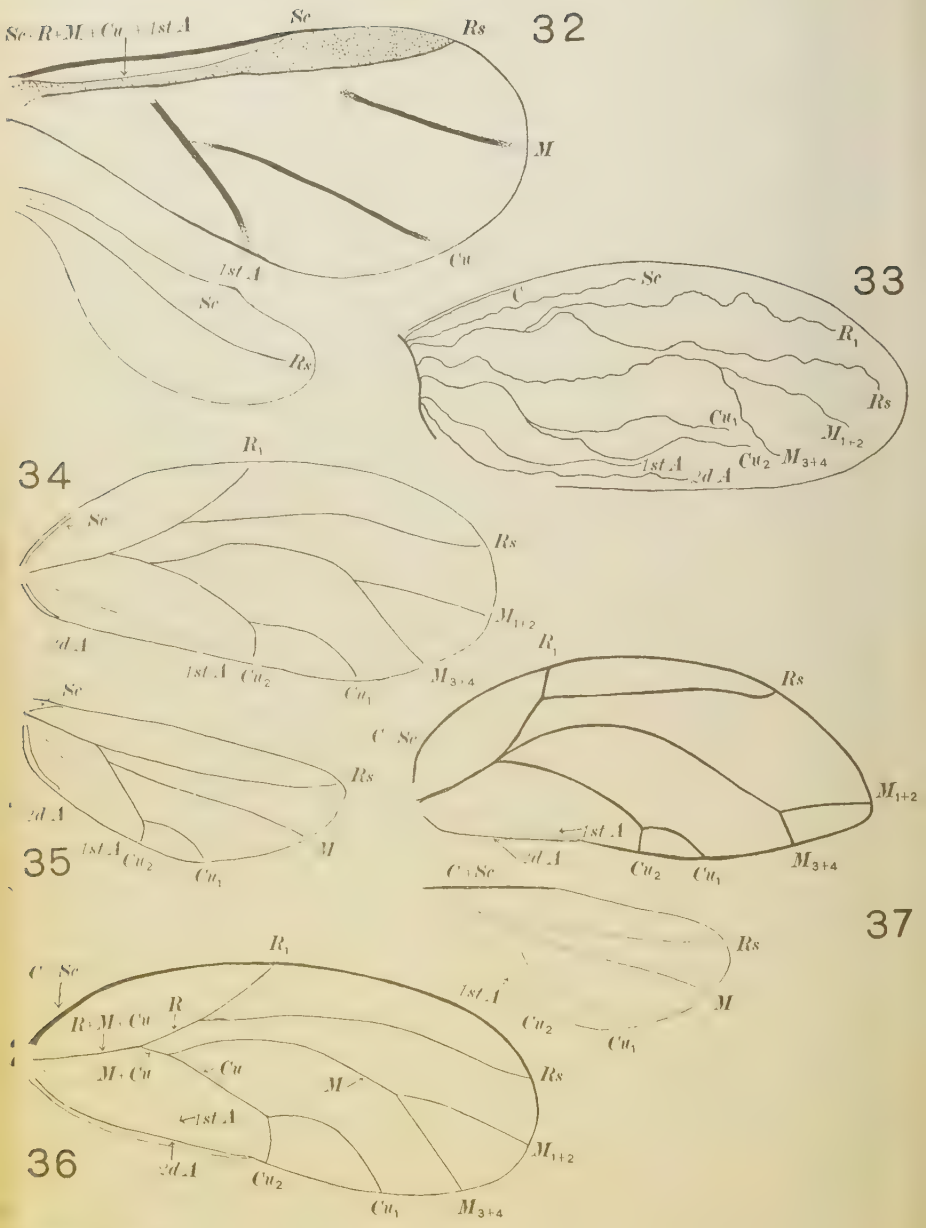




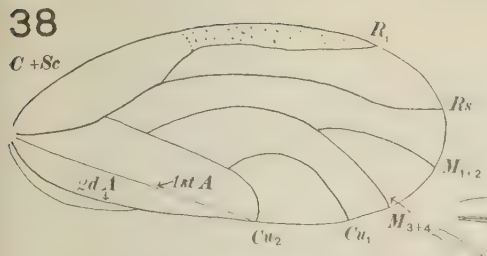
Edith M. Patch.

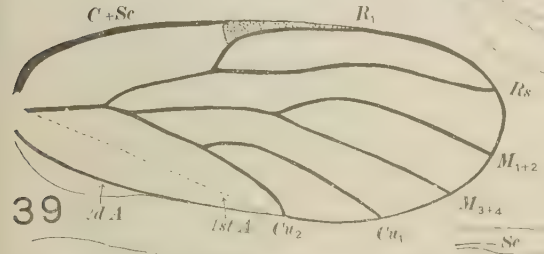


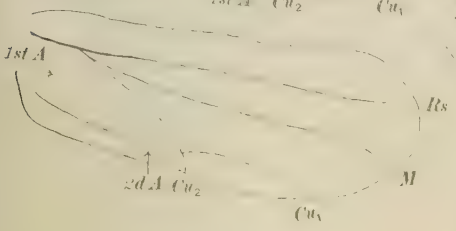
Edith M. Patch.

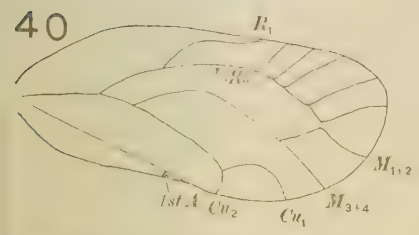


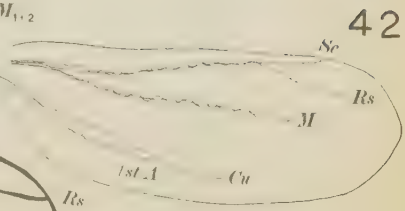
Edith M. Patch.

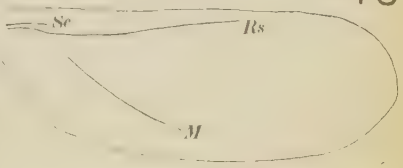


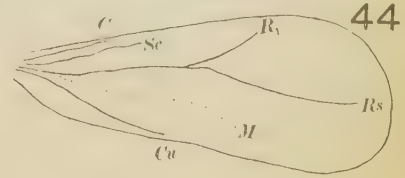












Edith M. Patch.

IMP. BUREAU, ENTOM
RECD 19 APR. 1913
319
ANSP.

Pemphigus venafuscus n. sp.*

By Edith M. Patch.

(Plate XVII)

On October 1, 1909, large numbers of a dark winged flocculent *Pemphigus* were observed by the writer to be settling upon the trunks of lilac bushes (*Philadelphus syringa vulgaris*) about half a mile from the University of Maine Campus. They sought the rough places in the bark and deposited the minute sex forms characteristic of this genus. A *Syringa* aphid seemed so remarkable an occurrence that the lilacs on the campus were examined and were found to be similarly sought by the same unknown species. This shrub was not, to all appearances, a haphazard choice on the part of the aphid, for maples, oaks, and numerous other trees close at hand were avoided.

It was a good flying season for aphids and a careful watch

*Papers from the Maine Agricultural Experiment Station: Entomology, 34.

was kept for about fifteen days during which time this *Pemphigus* was particularly numerous upon the wing. It was found to be seeking the bark of elm (*Ulmus americana*) and red ash (*Fraxinus pennsylvanica* Marsh). On the red ash they were seeking also the ash clusters of a gall mite where they deposited the true sexes as they did in the rough bark. (*Eriophyes fraxiniphila*, Hodgkiss, Me. Agr. Exp. Sta., Bul. 162, p. 367).

In all these situations on the bark of lilac, elm, and ash, and in ash clusters, the minute apterous males and females molted, mated, and the winter eggs were subsequently laid.

On May 13, 1909, the newly hatched aphids were observed to be crawling up the trunks of the lilac, and by May 20 they were found to be numerous on both the lilacs and ash where they had settled in the angles of the twigs or about the swelling buds. They were feeding, growing and excreting honeydew normally on both these hosts. Fine long bluish-white flocculent strands are secreted from six rows of abdominal glands giving the aphids a very downy appearance.

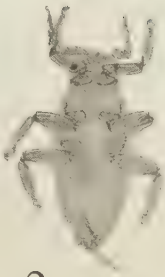
This is the first time in my observations of Pemphigus when I have found the same species chosing widely different hosts *for the same stage*. Whether the stem mothers of *Pemphigus venafuscus* are also able to develop upon the elm it has not yet been possible to ascertain.

The fall migrants of 1908 were on the wing for more than a month but the host plant which they had left was not located.

Reference to my *Pemphigus* records and mounted slides of 1906, however, showed specimens and notes of apterous viviparous, winged viviparous, pupae, and young of the same species which were found upon the twigs of ash June 21-29, 1906, at Orono. They did not occur on the leaves.

By reference to the Maine Station collection and through the kindness of other collectors of this genus I was enabled to compare specimens of this new *Pemphigus* with authentic specimens of thirteen named species of Pemphigus as well as several undescribed species. This comparison emphasized the

1



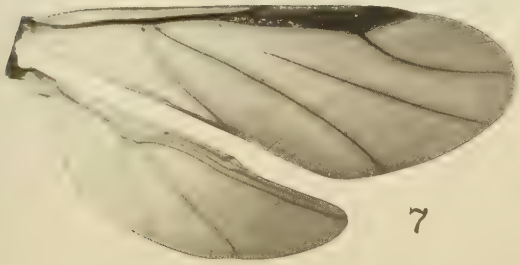
2

3

4

5

6



7

PEMPHIGUS VENAFUSCUS PATCH.

fact that *venafuscus* is a very distinctive species. The wings alone would serve to characterize it. Their dark, smoky condition is similar to that commonly found in *Lachnus*, but unusual for *Pemphigus*, and the venation is heavier than any known *Pemphigus*.

Pemphigus venafuscus n. sp.

Apterous viviparous.—Large dark brownish globular forms. Mottled in appearance due to six powdery discs on each abdominal segment, two nearly mid dorsal and a lateral line of two on each side. At time of collection these old forms were pulverulent rather than flocculent over the general body surface but they possessed a flocculent caudal tuft.

Length of antennae, 1.01mm. with segments as follows: I, .06 mm.; II, .15 mm.; III, .23 mm.; IV, .19 mm.; V, .18 mm.; VI, .2 mm. Total length of body exclusive of antennae, 3.5 mm.

Found in sticky, wooly colonies along twigs of ash chiefly on new growth but somewhat on old. Collected at Orono, June 21, 1906, together with minute progeny and pupae nearly ready for the last molt.

Winged viviparous. Pupae collected June 21 on ash twigs were saved in order to obtain the mature alate forms. The pupae were exceedingly flocculent over the whole surface of the abdomen. By June 29 they had molted and begun to produce.

Head, antennae, thorax and legs black. Abdomen greenish black and flocculent. Antennae and wings as in the fall migrants.

Body length, 3 mm. Beak extending over the first third of the abdomen.

Fall migrants. These winged *sexuparae* (form producing the true sexes) were taken on the wing and collected from the trunks of lilac, red ash and elm in October, 1908. At time of collection they resembled the other winged viviparous generation except that they were bluish black rather than greenish black and the abdomens of the migrant *sexuparae* are shrunken in appearance and not plump like the other viviparous forms.

Head, prothorax, and thorax and legs black, flocculent. Antennae black, 1.55 mm. in length with segments as follows: I, .1 mm.; II, .15 mm.; III, .55 mm.; IV, .25mm.; V, .275 mm.; VI, .225 mm. Straight transverse sensoria occur regularly spaced, varying slightly in number but averaging 19 on III, 10 on IV, 11 on V, 4 or 5 on VI., Asensorium, circular in shape, is distinct on distal 11. The usual terminal sensoria on V and VI. Near the base of III there is an irregular jut, the

rest of the segment is fairly even in outline. Wings smoky and dark with dark veins. Wing expanse 9 mm. Wings at rest usually deflexed but more often reposed than in most species.

In general, a blue-black species with blue-white flocculency. The wavy filaments are as long as the body and curl out from the side of the abdomen under the margin of the wings. The wax filaments are silky in appearance and are slightly fluted on some of the specimens. This condition of the filaments is true, of course, only for those individuals which have not become too much travel worn.

Oviparous female. An apterous non-rostrated form, yellow, with semi-transparent smoky white legs and antennae. Body length, 1.15 mm. Antenna, .28 mm. Five distince segments. Terminal sensoria on IV and V. Eyes a group of 3 pigmented areas.

Male. Apterous and non-rostrated. Body greenish with semi-transparent smoky white legs and antennae. Body length, .75 mm. Antenna, 2.75 mm. Five distinct segments. Terminal sensoria on IV and V. Eyes a group of 3 pigmented areas.

Both the male and the female molt once before copulation. A single egg is deposited, yellow and glistening with a downy white secretion. The egg subsequently turns glistening black.

EXPLANATION OF PLATE XVII.

Fig. 1. Oviparous female. On lilac, October, 1908. Actual length of body 1.15 mm.

Fig. 2. Male. On lilac, October, 1908. Actual length of body .74 mm.

Fig. 3. Pupa. On ash, June, 1906. Actual length of body 2.66 mm.

Fig. 4. Stem mother. Very young nymph. Collected from lilac, May, 1909. Actual length of body, exclusive of beak, 1.1 mm.

Fig. 5. Top of head and antenna of apterous viviparous form,—full grown stem mother. Actual length of antenna 1.01 mm.

Fig 6. Top of head and antenna of alate viviparous form, fall migrant. Actual length of antenna 1.55 mm.

Fig. 7. Wings of fall migrant.

...MP. BUREAU, ENT
REC'D ...R 1913
...48

The Desmodium Aphid, Microparsus variabilis n. sp.*

EDITH M. PATCH.

(Plates XVIII and XIX)

For the past few years a very distinctive aphid has been present in enormous numbers upon the Canadian tick-trefoil in the vicinity of Orono. On account of the size of the wing tracheæ and the abundance of material this was one of the species which the writer used in the study of wing venation and it was figured and named in that connection before the description of the species was put into shape. Although not as detailed as is desirable it is hoped that the description given here will serve to place this characteristic species.

MICROPARSUS n. gen.

The ensiform cauda, the hemispherical anal plate, the cylindrical cornicles, the moderate hairs with spatulate tips, and the

*Papers from the Maine Agricultural Experiment Station: Entomology 35.

form of the antennae all indicate a close relationship of this genus with *Macrosiphum*. It is clearly differentiated from *Macrosiphum* and any other named genus by the wing characters. The radial sector* is short and strongly curved. The media is typically two branched. The cubitus and first anal are heavily shadowed. The hind wing is minute, the tip extending only to about the first anal of the fore wing, and is correspondingly narrow. The costal hooks of the hind wing are very near the tip of the wing. Typically the hind wing has only the radius. The shape and relative size of these wings are better indicated by the accompanying figures than by a detailed description.

Microparsus variabilis n. sp.

The species under consideration is one of the most peculiar yet found in the family. I listed it first as *Macrosiphum* n. sp. as the cauda and cornicles would indicate. The head and antennae show *Myzus* tendencies, but the wings throw it out of any present genus. The heavy shadowing of the first anal and cubitus suggest the shadowed veins common in *Callipterus*. The two-branched media together with the frequent occurrence of a reversion of the three-branched condition presents a case similar to that of *Toxoptera*. The exceedingly small hind wing, however, and the very peculiar shape of the fore wing correlated with this are inconsistent with the characters of any named genus.

Mr. Sanborn in "Kansas Aphididæ" describes and figures the winged viviparous form of this or a closely allied species as *Macrosiphum* n. sp. and corrects this to *new genus, new species* in "Errata to Part I," but suggests no name in either instance.

This species may be *Macrosiphum desmodi* Williams which he lists on *Desmodium canadense* but as that species is *nomen nudum* there is no means of ascertaining.

Mr. J. T. Monell collected the same species thirteen years

*For the wing vein nomenclature, the reader is referred to "Homologies of the wing veins of Aphididae, Psyllidae, Aleurodidae and Coccidae." Annals of the Entomological Society of America. June, 1909.

ago and has graciously given me permission to use the notes with which he records his collection, as follows:

"On *Desmodium marilandicum*, St. Louis, Mo., August 12, '86. Covering leaves and stem in immense quantity. Colors alive under one-half inch pocket lens. *Apterous*. Head generally reddish yellow. Neck black. Tail yellowish to yellowish green. Dorsum yellow to yellowish green with few delicate irregular pale green markings. Apex of femora black. *Winged* the same. In the adult apterous is small dusky ring on abdomen enclosing nectary.

"33 wings had monofurcate 3d discoidal.
"14 wings had bifurcate 3d discoidal.
"24 wings had no discoidals.
"5 hind wings had trace of base of 2d discoidal."

Winged viviparous form.—Head light greenish brown. Hairs with spatulate tips present on head and antennae. Antennae black except basal III. Antennae much longer than body; 2.83 mm. with segments measuring I, 0.12 mm.; II, 0.08 mm.; III, 0.61 mm.; IV, 0.57 mm.; V, 0.49 mm.; VI (base), 0.12 mm.; spur 0.84 mm. Sensoria: A few (usually 5) circular sensoria in a more or less regular row on III; on V the customary terminal sensorium; and on VI the terminal with crowded group of 6 marginal sensoria. Eyes dark red. Ocular tubercles prominent. Beak 0.44 mm. long extending just caudad 3rd coxa. Thorax light brownish green, lobes glistening; prothorax with a dark longitudinal median line. Wings with veins dark brown. First anal and cubitus heavily shadowed, others unshadowed but heavy. Total expansion 5.4 mm. Hind wing extending only to the 1st anal of fore wing. Radius present and often the tip of media. Legs with the proximal two-thirds of femora very pale, distal one-third glistening dark brown, tibiae dark at proximal half and distal tip, with space between pale. Tarsi dark. Abdomen light green with dark patch at base of each cornicle. Cornicle dark brown, cylindrical, strongly and about uniformily imbricated throughout its length. Imbrications nowhere forming polygonal reticulations. A little larger at base than at the middle and slightly flared at tip. Cornicles 0.3 mm. long. Cauda light yellowish green, ensiform, upcurved, 0.24 mm. long. Anal plate hemispherical when seen from dorsal aspect. Total length of body, exclusive of antennae, 1.6 mm. Width 0.7 mm.

Apterous Viviparous Form.—Head light brown. Antennae with I, II, and basal III light, rest dark. Antennae longer than body, 2.62 mm. with segments measuring I, 0.14 mm.; II, 0.07 mm.; III, 0.62 mm.; IV, 0.48 mm.; V, 0.41 mm.; VI (base), 0.1 mm.; spur 0.8 mm. No sensoria on

III or IV, the usual terminal one of V and the terminal one with group of 6 crowded sensoria present on VI. Eyes red. Ocular tubercles prominent. Beak 0.43 mm., extending to 3rd coxae. Thorax and prothorax light green. Legs with femora light proximally and dark and glistening distally; tibiae dark at proximal and distal ends with light space between; tarsi black. Abdomen light green with dark ring at base of cornicle. Cornicle black, shaped and imbricated about as in the winged viviparous form. Cornicles 0.32 mm. Cauda light yellowish brown, ensiform, upcurved, 0.24 mm. Total length of body, exclusive of antennae 2 mm.; width .99 mm.

Apterous oviparous female.—Head light brown. Antennae black except basal III. Antennae longer than body, 2.62 mm. with segments measuring I, 0.15 mm.; II, 0.08 mm.; III, 0.6 mm.; IV, 0.48 mm.; V, 0.42 mm.; VI (base), 0.13 mm. Spur 0.76 mm. No sensoria except the terminal one of V and the terminal one of VI accompanied by crowded group of 6 marginal sensoria. Ocular tubercles prominent. Beak 0.44 mm., extending just caudad of 3rd coxa. Thorax light green. Legs colored as in winged viviparous form. Hind tibiae thickly set with sensoria. Abdomen light green with dark patch around cornicle. Cornicles dark brown, shaped and imbricated about as in the viviparous forms. Cauda light yellowish, ensiform, length 0.2 mm. Total length of body, exclusive of antennae, 2.25 mm. Width 1.01 mm.

Winged male.—Head light yellowish brown. Antennae black, longer than body, length 2.65 mm. with segments measuring I, 0.12 mm.; II, 0.08 mm.; III, 0.56 mm.; IV, 0.51 mm.; V, 0.41 mm.; VI (base), 0.12 mm.; spur 0.85 mm. Sensoria thickly set in III, IV and V. Terminal sensoria of V and group of VI similar to those of the other 3 forms. Ocular tubercles prominent. Beak 0.37 mm. reaching nearly to 3rd coxa. Thorax glistening brown. Prothorax light green. Wings with venation as in the alate viviparous form. Wings expand 4.95 mm. Legs colored as in alate viviparous form. Abdomen light green. Cornicles dark and strongly imbricated as in the other forms. Cornicles more uniformly cylindrical than in the other forms. Cauda lighter than abdomen, ensiform, about the length of tarsus, 0.12 mm. Total length of body, 1.125 mm.; width 0.56 mm.

The entire life cycle of the colonies observed in Maine is passed upon the Canadian or showy tick-trefoil, *Desmodium canadense* DC. The species reproduces upon the trefoil during the summer, and during July the colonies of apterous and alate viviparous forms thickly crowd the tips of the branches and the ventral surface of the leaves which become badly twisted and curled. From the middle of August to the middle

WORK OF MICROPARSUS VARIABILIS PATCH, ON DESMODIUM CANADENSE. FIGURE OF MALE.

of September the true sexes,—the winged males and the apterous oviparous females are abundant. Females kept in captivity deposit eggs upon the dried leaves and stems of the trefoil. A careful field examination of the infested plants late in September results in finding some eggs upon the stems and crumbled leaves of the trefoil, but the eggs are much more numerous upon the sticks and stones immediately about the base of the infested plant.

The colonies which furnish data for this species were found along a sandy stretch near Veazie, Maine, where the species has been exceedingly abundant for the past three seasons.

There is something indescribably distinctive about the species when observed even with the unaided eye. The first impression they give the finder is that "here is something out of the ordinary in the aphid line," before a detailed examination is made.

The large per cent. of abnormal veins both in the males and the alate viviparous forms in each season's collection made the examination of a great number of specimens necessary in deciding upon the type of venation normal for this species.

Too much stress should not be laid upon the colors of aphids as they vary more or less, the more recently molted individuals being in general paler than the others. Neither can the antennal measurements be taken as absolute as different individuals vary both as to the length of the entire antennae and as to the relative length of the different segments.

However, both the color scheme and the antennal measurements are a great convenience in the sum of characters, if given their relative values.

EXPLANATION OF PLATE XIX.

1. Head and antenna of apterous viviparous form.
2. Head and antenna of alate viviparous form.
3. Head and antenna of apterous oviparous female.
4. Head and antenna of male.
5. Head and antenna of pupa.
6. Wings, showing the type of venation most frequent for this species.

IMP. FOR. 8 - JUN. 1914 ENT.

The Canadian Entomologist.

VOL. XLI. GUELPH, SEPTEMBER, 1909. No. 9.

DOWNY PSYLLID OF ALDER, *PSYLLA FLOCCOSA*, NEW SPECIES.*

BY EDITH M. PATCH, ORONO, MAINE.

The Psyllid under consideration has been conspicuous upon the alder (*Alnus incana*, Willd.) each season during my acquaintance with the vicinity of Orono, Maine. As the host-plant is looked upon as a common nuisance, no attention has been paid to this insect from an economic standpoint, and no further thought was given it except to admire the plumy appearance of the alder tips during June, or to be annoyed because it was impossible to go through this growth without being covered by the somewhat sticky flocculent matter.

This Psyllid was found to be convenient to use in connection with a study in wing venation,† but it was not until that paper was about ready for press that I tried to determine the species, and found that it was undescribed, for America at least. The Psyllid was named in that paper, and the description held until the present season should give opportunities for a few colour and life-history notes.

If the fact that I am not a "Psyllidist" is revealed by the generic characters creeping into the description, the accompanying photographs will perhaps help out the deficiency.

The eggs are probably deposited upon the alder in the fall, as the newly-hatched Psyllids appear about the time the alder leaves are unfolding in the spring, and settle upon the ventral surface of the leaves.

On June 10, 1909, nymphs previous to the last (or pupal) instar were examined. Head and thorax, both dorsal and ventral, were pale green, the abdomen, both dorsal and ventral, was pale yellow. Eyes bright pinkish-red. Tips of antennæ, legs and beak dusky. Wing-pads small and full and not flat upon the dorsum as in the next stage. These nymphs were congregated on young leaves on the ventral side along the ribs. To the naked eye they presented a loose, woolly mass on account

*Papers from the Maine Agricultural Experiment Station: Entomology, 36.
†Homologies of the Wing-veins of Aphididæ, Psyllidæ, Aleurodidæ and Coccidæ.

Chelifer persimilis, n. sp.—This is extremely similar to *C. cancroides*. The male differs at once from *C. cancroides* by having the margins of the abdominal segments more strongly produced behind, and almost all of the segments are so produced (while in *C. cancroides* only a few of the basal segments are produced, and these not half as much). The palpus is similar to that of *C. cancroides*, but the tibia is more swollen on the inner margin, and the hand is heavier and the fingers slightly shorter and more curved. It is of the same size and coloration.

Specimens from Pecos, New Mexico (Cockerell); Las Vegas, New Mexico (Cockerell); Eagle Spring, Organ Mts., New Mexico, and Roswell, New Mexico, Aug. (Cockerell).

Chelanops partitus, n. sp.—Cephalothorax and palpi red-brown, former paler behind. Cephalothorax fully one and a-half times as long as broad; surface closely and minutely granulate, and with many short, clavate hairs. Trochanter strongly bigibbose behind; femur fully as long as width of the cephalothorax, slightly concave in front near the tip; tibia one and a-half times broader than the femur, evenly convex on outer side, inner side rather suddenly swollen and slightly tapering beyond; claw longer than the cephalothorax, hand about twice as broad as femur, hardly as long as tibia, tapering to the stout curved fingers, which are fully as long as hand; fingers with fine simple hairs, rest of palpus with short clavate hairs. Legs with short almost clavate hairs. Abdominal scutæ each with about eight clavate hairs on the posterior border.

Length, 3 to 3.5 mm.

From Pt. Yuma, Arizona. Related to *C. Arizonensis*, but not as darkly coloured, smaller, and the fingers are plainly longer than the hand.

Chelanops diversus, n. sp.—Cephalothorax dark brown, palpi dark red-brown, body and legs paler, scutæ brown, but the basal three are only brown near the middle. Cephalothorax barely longer than broad, densely granulate, with extremely short, almost clavate hairs; groove behind the middle, its ends curving forward. Palpi not as long as body, very heavy; femur rather broadest near base, as long as width of cephalothorax; tibia almost as long as femur, outer side evenly convex, inner side suddenly swollen and then nearly straight, barely broader than the femur; claw longer than cephalothorax and mandibles, hand very broad, about twice as broad as femur, broadest at base and tapering to the fingers, which are barely longer than width of hand, all with short fine hairs, those on femur and tibia almost clavate. Legs with short, simple hairs. Abdomen rather

BULLETIN No. 171.

THE PINE-LEAF CHERMES

AND

THE GREEN-WINGED CHERMES.*

EDITH M. PATCH.

THE PINE-LEAF CHERMES (*Chermes pinifoliæ* Fitch).

On account of recent troubles, varying in nature and importance, of the white pine in Maine a close watch has been kept over the pine by people throughout the State, which has resulted in their becoming interested in many insects of the white pine heretofore attracting but little attention.

Conspicuous among such insects during the early summer of 1909 was a dark reddish-brown plant louse, "The Pine-leaf Chermes" shown in Fig. 43 in its characteristic position on the pine needles where it settles to lay its eggs. This Chermes appears upon the pine needle about the middle of June, and some years in conspicuous numbers.

The past summer (1909) hardly a pine in the vicinity of Orono could be found that was not abundantly infested with these winged forms and that the same was true in other parts of the State was shown by specimens submitted to the Station. One such report from Gilead June 25, accompanying specimens, read "Millions of the flies on white pine."

The eggs of this species are not expelled from the bodies of the females. The insects attach themselves firmly to the pine needles with their heads toward the base of the needle and die there with the eggs held in the abdomen which is like a little sac protected by the wing of the parent *Chermes*. Such a

* Papers from the Maine Agricultural Experiment Station: Entomology No. 37.

cluster contains about 100 eggs. These hatch in 8 or 10 days from the time the Chermes appear on the needle of the pine. The young settle about the new growth of the shoot and piercing the tender tissue with their beaks, suck the sap. Where the infestation is heavy this causes a yellowish and sickly appearance of the new growth which is sometimes thus considerably stunted. The young, though exceedingly minute, can be located because they produce a white flocculent waxy secretion which makes their presence discernable.*

The Pine-leaf Chermes is one of those species of plant lice that have alternate "host plants," that is, they pass one stage of their life on one plant and the succeeding stage on another species of plant.

The winged Chermes that appear suddenly upon the needles of the pine in mid-June have not developed on the white pine but in a cone-like gall common on the Red Spruce and Black Spruce, see Fig. 44. This gall is an abnormally developed shoot, the unusual form of growth being stimulated in some way by the presence of the Chermes. The young Chermes can be found in these galls by opening the sections of the galls where little reddish brown objects will be seen,—the developing Chermes.

These galls though sometimes very abundant in Maine are likely to escape notice as they are so cone-like in appearance as to seem to the superficial glance a normal part of the spruce. They were observed by Packard as common in Maine and the plant louse forming them was named *abieticolens* in 1879, the fact that they were the same species Fitch recorded for the pine needle not being known at that time.†

---

*Another much smaller species of plant louse (*Chermes pinicorticis*) is frequently present on the trunk of the same tree in such numbers as sometimes to cover almost the entire trunk with a white down.

† This species develops in a cone-like gall on the black and red spruces (in which connection it was named *abieticolens* in 1879 by Thomas and subsequently merged by error with *abietis* in 1897), and migrates to the needles of the white pine (in which connection it had been previously named *pinifoliae* by Fitch in 1858, and merged by error with *pinicorticis* in 1869). This historical discussion with full reasons for resurrecting this doubly merged species under the original name of *pinifoliae*, which has been discarded for about 40 years, will be published presently in more technical form by the Maine Agricultural Experiment Station. For the purposes of this economic bulletin it is not necessary to include either detailed descriptions or discussion.

The full grown Chermes acquire wings about the middle of June when they leave the spruce galls and seek the white pine.

Remedial Measures. There would seem to be no practical method of combatting this insect in forest growth. With ornamental trees, however, the galls could be removed from the spruce previous to the emerging of the winged form. Also if the species proves constantly troublesome it might be desirable not to plant the white pine in the vicinity of black or red spruce and *vice versa.*

Spraying with whale-oil soap (1 pound to 2 gallons of water) would doubtless destroy the young on the white pine shoots, but it is doubtful that this would be usually worth while in Maine where Syrphus flies abound. The larvæ of these, little light colored maggots, have been found to feed industriously on the young Chermes. So numerous are these beneficial maggots at times in the midst of the white waxy secretion of the Chermes that they are sometimes mistaken by people submitting them for determination as the cause of the trouble.

THE GREEN-WINGED CHERMES (*Chermes abietis* Linn).

An entirely different sort of gall common in Maine on the White Spruce, and Norway Spruce, is caused by another species of Chermes which is here termed the "Green-winged Chermes" as the conspicuous and constant green tinge of the wings is a character which will readily serve to distinguish it from the "Pine-leaf Chermes" by those who would find a more technical comparison troublesome.

Fig. 45 shows 3 of these galls together with 6 cones, about natural size on a white spruce twig. It will be seen that these galls differ from those shown in Fig. 44 in not being cone-like and in not being characteristically terminal on the shoot. These *abietis* galls do not usually cause the death of the shoot on which they grow but they do cause deformed branches and frequently ruin a small tree for ornamental purposes. Such galls are very abundant on the Norway spruces on the University of Maine Campus. That they are troublesome on native spruce in this locality is shown by the fact that on a single white spruce 3 feet tall more than 990 of this season's galls were counted August 1, 1909. Where so numerous, these galls are much smaller than those shown in Fig. 45.

These galls begin to open about August 15 in Maine. The full grown pupæ walk out on the spruce needles, where they molt their pupal skins. The newly emerged winged insect is yellowish with distinctly green wings and even the wings of the aged specimens retain the green color.

Unlike the Pine-leaf Chermes, this Green-winged Chermes does not use alternate host plants. That is, it does not seek the pine or any different kind of tree to lay eggs on than that on which it produces the galls. Shortly after emerging from the gall it lays its eggs on the spruce and the young which hatch from them do not acquire wings but develop to a wingless form living solitary over winter on the twig. This is the form that lays eggs in the spring for the generation that causes the development of the gall which shelters them.

Remedial Measures. Spraying the trees in April with whale-oil soap solution (1 pound to 2 gallons of water) has been reported as effectual. (34th Report Mass. Agric. College). The practice of removing and burning the galls will serve to control this species sufficiently on ornamental trees. At Orono great numbers of the winged forms are caught in spiders' webs that are spun irregularly over the spruce twigs.

Fig. 43.—The Pine-Leaf Chermes. Migrants from the spruce-gall to the white pine.

Fig. 44—Black spruce twig with two cone-like galls caused by the Pine-Leaf Chermes.

FIG. 45—Twig of white spruce with three "pine-apple galls" of *Chermes abietis* and six normal cones.

BULLETIN No. 172.

THE MYCETOPHILIDÆ OF NORTH AMERICA.

Part I.*

O. A. Johannsen.

It is the purpose of this paper to present a synopsis of the fungus gnats or *Mycetophilidæ* of North America, giving descriptions of and tables to all the genera and species, and life histories when known. As these flies are for the most part quite small, inconspicuous in coloring and retiring in habit, it is not strange that they, with the exception of a few species which have been brought into prominence by reason of their economic importance, have received but scant attention from entomologists generally. In this, the first part, the lower and economically less important subfamilies are treated, while in a subsequent paper the *Sciophilinæ*, *Mycetophilinæ* and the *Sciarinæ* will be considered. I hope to be able to show, in my work on the *Sciarinæ*, just what relation the larvæ of *Sciara* which are so frequently and usually so numerously present in rich soil, bear to the plants which grow there. I also trust that the descriptions of the imagines of the members of this genus will be sufficiently characteristic so that neither the Economic Entomologist nor the Systematist need so often designate a species as *Sciara sp.* as has been the case heretofore.

Acknowledgments.

To the members of the Entomological Staff of Cornell University for their kindness in granting me the freedom of their laboratories, library, and collections I wish to express my

*Papers from the Maine Agriculture Experiment Station: Entomology No. 38.

heartiest thanks. I am also under great obligations to Professors W. M. Wheeler, J. M. Aldrich, John Barlow, and Messrs. Wm. Beutenmueller and C. W. Johnson for the loan of their collections, to Mr. D. W. Coquillett in permitting me to study the specimens in the United States National Museum and to Dr. Samuel Henshaw for the privilege of examining the Loew types in the museum at Cambridge, Mass. I desire also to acknowledge my indebtedness to Miss Edith M. Patch of the Agricultural Experiment Station of Maine, and to Dr. Chas. D. Woods, director of the station, for encouragement and aid in making possible the publication of this paper in its present form.

Of the literature upon the Mycetophilidæ which has been of greatest assistance I need only mention here Winnertz's "Pilzmücken," the "Centuries" of Loew from the Berliner Entomologische Zeitschrift, and the papers of Adams, Aldrich, Coquillett, Dziedzicki, Grzegorzek, Lundström, Marshall, Rübsaamen, Skuse and Williston.

Characters.

The fungus-gnats are flies of medium or small size, and more or less mosquito-like in form. They are exceedingly numerous both in number of individuals and in number of species, over fifteen hundred species contained in upward of one hundred genera, having been described from Europe, North America and Australia. Although entomologists have long been familiar with the earlier stages as well as with the adults of several members of this family, our knowledge of the life history is as yet very meagre. In 1864 Baron C. R. von Osten Sacken collected all the published records bearing upon the biology and the structural characters of the larvæ and published them together with some observations of his own. This paper was reprinted in 1884 with a few additions.

The larva is twelve segmented, footless, more or less cylindrical, slightly tapering, smooth, soft, whitish in color and with a small strongly chitinized head, which is usually brown or black. The antennæ are always very minute, almost vestigial. The mouth parts consist of a fleshy labrum, with a chitinized frame; flat lamelliform mandibles, indented or serrate on the

inner side; maxillæ with inner and outer lobes, the former usually serrate; and a small chitinized labium. The body of the larva is without hair or bristles except that in some genera there are two transverse rows of simple or bifid ambulacral setulæ on the margin of each abdominal segment on the ventral side. There are usually eight pairs of spiracles, which in some of the genera at least, are protected by small chitinized conical projections, the anterior pair being largest.

The pupæ are extricated, that is, not encased in the contracted skin of the larva. The legs are applied to the breast and venter, the antennæ are bent around the eyes, and extend between the wings and legs. The prothoracic spiracle is placed a little above the root of the wing and immediately behind the antenna. The abdominal spiracles are distinct on both sides of the abdomen. The pupa is smooth, white in color and frequently encased in a delicate cocoon. The pupæ of those forms whose larvæ live in mushrooms are usually found in the soil and among the decaying parts of the plant. The larval and usually the pupal life also is of short duration, though the insect may hibernate as a pupa. The time which elapses from the egg to the adult stage may not exceed two weeks in midsummer.

The imago may be distinguished from other flies by the following characters: Antennæ usually 16 jointed, occasionally 12 to 17 jointed; palpi usually 3 or 4 jointed; ocelli present except in one or two genera. Thorax highly arched, scutellum small, setose. Abdomen with 6 to 9 visible segments, cylindrical, conical or oval and laterally compressed; the male with complex hypopygium, the female with a short ovipositor with 2 terminal lamellæ. In the male the seventh and eighth segments are usually very small. The coxæ are very strong and excepting in the *Sciarinæ* and a few of the lower genera, are much elongated; the femora are more or less thickened, laterally compressed, often setose; the tibiæ usually slender, spurred, and setose; tarsal claws with teeth. The wings are usually oval, hairy or microscopically setulose, and without the cell 1st M_2 (discal cell). The wing venation is quite varied though it may readily be reduced to four types. The first and most primitive is that of *Palæoplatyura* (fig. 70); in the second, *Ceroplatinæ, Macrocerinæ, Ditomyia* (fig. 71) the basal section

of the media is lost; in the third, *Sciophilinæ* (fig. 72) the M-Cu cross vein is wanting and R_{2+3} is crossvein-like in appearance; while in the fourth, *Mycetophilinæ* (fig. 73) and *Sciarinæ*, both the M-Cu crossvein and the vein R_{2+3} have disappeared either by coalescence or atrophy.

Below is given the Comstock-Needham terminology of wing venation which is used in the following text, together with the equivalent terms of the Schinerian system.

Costa (C)		= Costa.
Subcosta (Sc)	Sc_1	= Subcostal or auxiliary vein.
	Sc_2	= Subcostal crossvein.
Radius	..... R_1	= First longitudinal vein.
	Radial sector R_{2+3}	= Anterior branch of third vein.
	R_{4+5}	= Posterior branch of third vein.
Media (M)		= Fourth longitudinal vein.
Cubitus (Cu)		= Fifth longitudinal vein.
Anal veins (A)		= Anal and axillary veins.

Crossveins

Subcostal (Sc_2)	= Subcostal.
Radio-medial (R-M)	= Anterior crossvein.
Medio-cubital (M-Cu)	= Posterior crossvein.

In this system each cell is given the name of the section of the vein immediately in front of it; thus the cell behind the costa is called the costal cell (or C); the cell behind the basal section of the radius is called R, that behind R_1 is called R_1, etc. In the case of *Sciophilinæ* where R_{2+3} is transverse in position, the small cell is called R_2 and the outer cell is R_{2+3}. Some writers, Winnertz among others, have erroneously considered the base of the radial sector as a crossvein, while they called the true crossvein the base of the third longitudinal vein (R_{4+5}).

In the past the characters most used for generic classification have been derived from the wing venation while color characters have been most used in describing species. In the

future more attention should be paid to the structure of the palpi and antennæ, position of ocelli, arrangement of setæ on thorax and legs, relative wing and leg measurements, claws in some cases, and especially to the hypopygium of the male, for both generic and specific characters. The descriptive works of Dziedzicki, Lundström and Rübsaamen, are particularly excellent in regard to the last. For a proper study of the members of the *Mycetophilidæ* it is absolutely necessary to make a caustic potash preparation of the hypopygium. It is impossible from a pinned specimen to determine the form of the parts, owing to the fact that they are usually more or less retracted. I have found Lundström's method of preparation simpler than that of Dziedzicki. In this method it is merely necessary to relax the insect, cut off with a pair of scissors the apical segments of the abdomen; immerse in a 10 per cent solution of caustic potash for twenty-four or more hours, soak in water to remove the potash, and finally preserve in alcohol in a tiny vial bearing the number of the specimen. Besides its simplicity this method offers a further advantage in that the abdominal segment which still is attached to the hypopygium offers a hold for the needles in manipulating and arranging the part under the binocular dissecting microscope. Slide mounts alone are not desirable since it is necessary to be able to turn the object in order to see it from all sides.

The general shape of the hypopygium is that of a cup opening posteriorly, the cavity of which is the genital chamber. This cup, which is formed of the sclerites of the ninth segment, is so produced that its margin usually extends beyond the tenth segment which morphologically terminates the abdomen. The tenth segment bears the anus and is usually reduced to a small membranous lobe. Attached to the posterior rim of the hypopygium are several lobe-like appendages which are variously formed or modified. The body of the segment is made up of a dorsal, ventral and two lateral sclerites. From the floor of the genital chamber arises the penis with its variously modified guards. Although several hundred preparations have been made, owing to the complexity of structure I am not yet certain of the homologies of the parts of some of the genera and pending this investigation I must be content in the descriptive work which follows to confine myself to noncommittal

terms in the designation of the various appendages. Following Dziedzicki and Lundström I shall call the upper and lower lateral appendages respectively the upper and lower forceps; when the homology seems evident I shall use the terms eighth and ninth tergum and sternum as given by Snodgrass ('04), otherwise shall speak of these appendages as the dorsal and ventral sclerites. Sometimes when one or the other of the lateral appendages are wanting or greatly reduced the remaining pair will be simply designated as the forceps. When there are appendages of sternum and tergum which require designation they will be called respectively sternal and tergal processes or lobes.

Habits and Economic Relations.

As far as known most of the members of this family live upon and destroy mushrooms, not only the wild plants but on occasion the cultivated varieties as well. Many a mushroom though apparently sound, will, upon close scrutiny reveal tiny black headed larvæ which within a few days grow to maturity and if numerous completely riddle the plant. If left upon the earth the larvæ when full grown will bury themselves, pupate, and within a short time emerge as adults. While but few references to the higher fungus gnats (*Mycetophilinæ*) are found in economic literature, nevertheless I may say from personal observation that a large percentage of the wild mushrooms are infested with the larvæ of *Mycetophilinæ*, particularly of the genera *Exechia* and *Mycetophila*, and in several instances have found them in company with the larvæ of *Phora* to utterly ruin a mushroom bed in the cellar of a grower.

The larvæ of *Mycetobia* live upon decaying wood, particularly of the apple or peach tree, though probably without injury to the sound wood. The *Ceroplatinæ* and *Sciophilinæ* as far as known live upon fungi and decaying wood. As they are comparatively rare they are not likely to be of economic importance. The *Sciarinæ* on the other hand are frequently mentioned by economic entomologists. Though often found in decaying mushrooms and in the earth in putrid vegetable matter I have never found them to be injurious to growing fungi. They are frequently present, feeding on potatoes affected by scab or rot, in some apparently well authenticated instances

appear to be the precursor of some form of scab. They are found in apples associated with the railroad worm; in bulbs of tulips, and are occasionally reported by florists as damaging plant roots. Professor Forbes in the 18th report of the State Entomologist of Illinois states that they are frequently noticed in rich garden ground and among potted plants, where they are accused by gardeners of eating the roots and hollowing out the bulbs. He also says "When the spring is cool and wet after corn planting, so that the softened seed lies long in the ground without sprouting, this is especially liable to certain kinds of injury; and it is under these conditions that the black headed maggot (*Sciara sp*) seems most likely to affect it injuriously. Rotting grain is, indeed undoubtedly preferred by this insect, but it has occasionally been seen to infest kernels which had begun to grow. It lives normally in old sod, feeding chiefly, or perhaps altogether, on decaying vegetation there, and will be found in noticeable numbers in corn fields only where the field was in grass the preceding year. These maggots penetrate and hollow out the kernel, often leaving nothing more than an empty hull. A score or more of them may infest a single grain."

Lintner in his 10th report of the State Entomologist of New York says "A species (perhaps more than one) is noted in Europe, for its gregarious and migratory habits. It is there known as the army-worm or *Heerwurm* from its collecting at certain seasons in companies—sometimes consisting of millions —and traveling along in a body of often from 12 to 15 feet in length and 2 or 3 inches broad and perhaps a half inch thick. 'M. Guérin Méneville observed columns as many as thirty yards in length.' The species has not been positively determined, but it is accepted as either *Sciara Thomæ* (Linn.) or *S. militaris* Now.—but probably the latter, according to the statement of Baron Osten Sacken. Similar gatherings have been observed in this country, one of which is narrated in *Insect Life,* iv, 1891, page 214; two others recorded by Glover in the *Report of the Commissioner of Agriculture* for 1872, p. 115, as observed in Virginia (figures of the larva and fly are given); and two others by Prof. F. M. Webster, in *Science* for February 23, 1894, p. 109. With us they bear the name of 'snake-

worms,' from the snake-like appearance and movements of some of the processions."

Nothing further need here be said concerning habits as it is proposed to discuss more fully the details of life history and of injury caused by any given form under the respective species.

Remedial Measures.

As a remedy against those species which feed upon the cultivated mushrooms Lintner in his 10th report suggests occasional applications of pure and fresh pyrethrum in water, using it of the strength of one ounce to 4 to 8 gallons of water, as the larvæ may be deeper beneath or nearer to the surface of the beds. As a preventive measure the cellars may be closely screened and the beds covered with small mesh screen frames. For those which are associated with scab or rot the measures taken in combatting these will also hold in check the ravages which may be occasioned by the insect. The remedies and preventive measures applied for the railroad worm or apple maggot and the codling moth will also control the apple midge.

TABLE OF SUBFAMILIES.

a. Medio-cubital crossvein (M-Cu) present; i. e., a vein connecting the media with the cubitus (figs. 70, 71), or these veins contiguous for a short distance at the place where the crossvein usually is.

b. The radio-medial crossvein (R-M) distinct, not obliterated by the coalescence of a portion of radius and media.

c. Radius with more than 2 branches, anterior branch of the radial sector sometimes short and crossvein like.

d. The M-Cu crossvein far proximad of the R-M crossvein, the cell M less or but little more than half as long as cell R. (figs. 74-76). 1. Sub-fam. *Bolitophilinæ*.

dd. The R-M and the M-Cu crossvein nearly equidistant from the base of the wing, usually only one basal cell.

e. The radius with 4 branches (European). Sub-fam. *Pachyneurinæ*.

ee. The radius with but 3 branches (figs. 77-81), 2. Sub-fam. *Mycetobiinæ*.

cc. The radius with but 2 branches (fig. 91). 3. Sub-fam. *Diadocidinæ*.

bb. The radio-medial crossvein (R-M) obliterated by the coalescence of a section of the basal portion of the radius and media at the point where the crossvein usually is. (Figs. 82-90).

c. Antennæ short, usually thick set and often flattened. (Figs. 82-89). 4. Sub-fam. *Ceroplatinæ*.

cc. Antennæ very slender, and nearly as long and often much longer than the body (fig. 90). 5. Sub-fam. *Macrocerinæ*.

aa. The medio-cubital crossvein (M-Cu) absent.

b. The anterior branch (R_{2+3}) of the radial sector distinct, short, ending in R_1 and appearing like a supernumerary crossvein bounding distally the small rectangular or trapezoidal cell R_1 (fig. 72). 6. Sub-fam. *Sciophilinæ*.

bb. R_{2+3} not distinct from R_{4+5}, the cell R_1 thus open to the margin of the wing.

c. Coxæ much elongated, (fig. 56), the R-M crossvein usually distinctly angulated from the second section of the radial sector; the cubitus usually forks noticeably distad of the base of the wing (fig. 73). 7. Sub-fam. *Mycetophilinæ*.

cc. Coxæ not greatly elongated; the R-M crossvein in the same right line with the second section of the radial sector; the cubitus forked near the base of the wing. 8. Sub-fam. *Sciarinæ*.

1. Subfamily BOLITOPHILINÆ.

Bolitophilinæ Winnertz, Verh. Zool-bot. Ges. Wien, XIII, 657. 1863.

Long slender species, with abdomen having 7 to 9 visible segments, 12 to 17 jointed antennæ, coxæ either long or short; wings long and rather narrow; radius 3 branched, both the

basal cells R and M distinct and closed at the distal end by the crossveins or by the coalescence of the basal section of the media and cubitus; the cell M much shorter than the cell R.

Table of genera.

a. R_{2+3} shorter than the distance of its base from the crossvein and shorter than R_{4+5}.
   b. Antennæ 17 jointed, slender (figs. 75, 76). 1. *Bolitophila.*
   bb. Antennæ 12 jointed (fig. 74). 2. *Hesperinus.*
aa. R_{2+3} much longer than the distance of its base from the R-M crossvein (fig. 79). Fossil genus. 3. *Mycetophætus.*

1. Genus *Bolitophila* Meigen.

Bolitophila Meigen, Syst. Beschr. Zweifl. I. 220. 1818.
Messala Curtis, Brit. Ent. 581. 1836.

Head hemispherical; 3 ocelli arranged in a curved line on the broad front; palpi 4 jointed; antennæ filiform, in the male nearly as long as the body, of the female shorter, 2+15 jointed. Thorax small, highly arched. Abdomen slender, of the male with 8, of the female with 9 visible segments. Legs slender, tibial spurs short and weak. Venation as figured (figs. 75, 76).

Table of species.

a. Anterior branch of the cubitus disconnected at the base (fig. 76). 1. *disjuncta*
aa. Anterior branch of cubitus connected at the base.
   b. R_{2+3} ends in R_1 (fig. 75). 2. *cinerea.*
   bb. R_{2+3} ends in the costa.
      c. The subcosta ends at or distad of the base of the radial sector in the male. 3. *hybrida.*
      cc. The subcosta ends noticeably proximad of the base of the radial sector. 4. *montana.*

1. *Bolitophila disjuncta* Loew.

1860. *disjuncta* Loew. Beschr. europ. Dipt. I. 19. 17.

Male. Length 6 mm. Head cinereous, proboscis brownish, palpi yellowish; antennæ about as long as the insect, fuscous,

scape and base of the flagellum yellow. Mesonotum with 3 broad cinereous stripes; the humeri, space between the stripes, yellow. Pleura, sternum and metanotum brownish. Abdomen wholly fuscous. Coxæ and legs yellow, tibiæ and tarsi slightly infuscated, fore metatarsus about .9 as long as its tibia, claws minute, apparently simple, pulvilli plumose, empodium like a stag's horn. Wings (fig. 76) hyaline, distinct brownish stigma at apex of R_1, subcosta ends in the costa less than the length of the R-M crossvein before the base of the radial sector, R_{2+3} ends in the costa slightly distad of the tip of R_1, base of Cu_1 wanting, veins yellowish. Length of wing is 6 millimeters which is twice as long as the fore tibia. Halteres yellow, knob brown. Several specimens collected by Prof Aldrich, Juliaetta, Idaho. The specimen in the Loew collection at Cambridge is from New Hampshire.

2. *Bolitophila cinerea Meigen.*

1818. *cinerea* Meigen, Syst. Beschr. I. 221.

Male and female. Length 4 to 6 mm. Antennæ fuscous, yellowish at the base, shorter than the body; palpi yellow. Thorax light brown, grayish pollinose, mesonotum subfuscous with yellowish humeri, sometimes with indications of 3 longitudinal stripes; scutellum brown; abdomen brown. Coxæ and femora yellow, the latter and the tibiæ sometimes subfuscous, tarsi brown, fore metatarsus is .85 times as long as its tibia. Wing (fig. 75) cinereous tinged, with brown veins and pale subobsolescent stigma, subcosta ends distad of the base of the radial sector, R_{2+3} ends in R_1, the M-Cu crossvein present, though short and stout. Length of wing is as long as the body which is about 1.75 times as long as the fore tibia. Halteres with brown knob.

Several specimens. Ithaca, N. Y. May and September.

3. *Bolitophila hybrida* Meigen.

1804. *hybrida* Meigen, Klass I. 47.

1818. *fusca* Meigen, Syst. Beschr. I. 221.

Male and female. Length 4 to 6 mm. Palpi pale, face, front and vertex brown, antennæ brown, yellow at the base. Thorax pale brown, dorsum pale brown, or more yellowish

with 3 brown stripes. Scutellum yellowish. Coxæ and legs yellowish, tibiæ and tarsi more or less brown; tibiæ and tarsi of hind legs subequal in length. Wing cinereous tinged, veins and stigma brown; sometimes with indistinct spot just distad of the R-M crossvein; the subcosta ends in the costa distad of the base of the radial sector, at least in the male; the M-Cu crossvein present, though short and stout. Halteres with brown knob. White Mts., N. H. (det. Coquillett) and Mayfield Cave, Ind. (det. Adams). Selkirk Mts., B. C.; collected by J. C. Bradley.

4. *Bolitophila montana* Coquillett.

1901. *montana.* Coquillett, Proc. U. S. Nat. Museum, XXIII. 593.

Female. Length 4.5 mm. Dark brown, the base of the third antennal joint, peduncle of the halteres, coxæ, femora and tibiæ light yellow, sides of mesonotum largely brownish yellow, mesonotum polished; wings hyaline, stigma elongate oval, gray; subcosta reaches only slightly beyond middle between humeral crossvein and base of the radial sector, R_{2+3} terminates in the costa, the media at its base coalescing for a short distance with the upper branch of the cubitus. Mount Washington, N. H.

Male specimen from Ithaca, New York, taken in September has the antennæ over 3-4 as long as the body, and the fore metatarsus .9 as long as its tibia, which is half as long as the wing. It differs from the female in having a shining black mesonotum and dark brown pleura, and also in the length of the subcosta which ends somewhat distad of the point midway between the subcostal crossvein (not humeral crossvein) and the base of the radial sector.

2. Genus *Hesperinus* Walker.

Hesperinus Walker, List Dipt. Brit. Mus. I, 81. 1848.

Spodius Loew, Berl. Ent. Zeitschr. II. 108. 1858.

Rather large, bare, blackish species resembling *Bolitophila* in habitus. Head small, round, palpi incurved, 4 segmented; antennæ 12 jointed; eyes round, ocelli 3. Abdomen slender, with 7 or 8 visible segments. Legs long and slender, coxæ not

elongate; femora somewhat thickened distally; tibiæ with small spurs; metatarsi lengthened, claws small, pulvilli and empodium distinct. Wings large and broad; Sc long, extending beyond the middle of the wing; R2+3 shorter than the distance of its base from the R-M crossvein, the media rises at the base of the wing, the fork of the cubitus and the M-Cu crossvein equidistant from the base of the wing and far proximad of the R-M crossvein (fig. 74).

Hesperinus brevifrons Walker.

1848. *brevifrons* Walker. List. Dipt. Brit. Mus. I. 81.

Female. Length 6 mm. Wholly fuscous, legs, halteres, and center of tergum of each abdominal segment paler than thorax. Front broad, with 3 large ocelli arranged in a triangle, the middle ocellus most cephalad; palpi 4 jointed, the first and second but little longer than broad, the third more slender, about 4 times as long as broad, the fourth slightly longer than the third, each joint with 10 to 15 stout black setæ as well as with very minute setulæ which are arranged in transverse rows; antennæ 12 jointed, the first and second broader than long, the third about 3 times as long as broad, the remaining 9 joints about as broad as long and only slightly diminishing in size apically, with few short setæ. Antennæ if bent back would scarcely reach scutellum. Thorax with indications of 3 broad cinereous stripes, almost bare. Abdomen with 9 visible segments, nearly bare, ovipositor with 2 slender oval lamellæ. Legs long but rather stout, tibial spurs very short, inconspicuous and depressed. Fore metatarsus about .4 the length of the tibia, tarsal claws apparently simple, empodium pad-like, pulvilli conspicuous. Wings cinereous hyaline, veins pale fuscous, except M-Cu crossvein which is paler, stigma faintly indicated; venation as figured (fig. 74); subcostal crossvein present, anal vein slender, rather faint but prolonged to the wing margin. Length of wing 6 mm. which is 2 2-3 times the fore tibia in length. Mt. Greylock, Mass. June. C. W. Johnson, collector. The species has been recorded from Alaska, Canada, Colorado, and White Mountains, New Hampshire.

The specimen in the U. S. National Museum determined as this species as I recollect seeing it, is the same as the one

described above. In habitus it reminds one far more of the Bibionid genus *Plecia* than it does *Bolitophila*, from which it differs mainly in having 12 antennal joints and but 4 palpal joints. I believe it should be placed with the Bibionidæ.

3. Genus *Mycetophætus* Scudder.

Mycetophætus Scudder. Bul. U. S. Geol. Survey 93. 19. 1892.

This fossil genus appears to be closely akin to *Hesperinus*, differing mainly in having a much longer R_{2+3}. Venation as figured (fig. 79). Legs long and slender, the fore femora considerably longer than the thorax, the tibia longer than the femora, both abundantly spinose. Abdomen 8 segmented. The only species is M. intermedius Scudder, from Florissant, Colorado.

2. Subfamily MYCETOBIINÆ.

Mycetobiinæ Winnertz. Verh. zool.-bot. Ges. Wien. XIII. 666. 1863.

A group possessing in common the following characters; 16 or 17 jointed antennæ; 3 ocelli on the vertex; wings rather broad, both the R-M and the M-Cu crossvein present and nearly equidistant from the base of the wing; radius 3 branched; legs long and slender and the tibial spurs rather short.

Table of genera.

a. Subcostal vein (Sc_1) long, reaching at least 1-4 the length of the wing and usually ending in the costa.
  b. R_{2+3} and R_{4+5} both arise at the R-M crossvein. (Fig. 77). 1. *Mycetobia.*
  bb. R_{2+3} and R_{4+5} separate distad of the crossvein. (Fig. 78). 2. *Palæoplatyura.*
aa. Subcostal vein (Sc_1) vestigial.
  b. The media forks distad of the base of R_{2+3}. (Fig. 80). 3. *Ditomyia.*
  bb. The media forks proximad of the base of R_{2+3}. (Fig. 81). 4. *Symmerus.*

1. Genus *Mycetobia* Meigen.

Mycetobia Meigen, Syst. Beschr. I. 229. 27. 1818.

Head spherical, flattened in front, 3 ocelli arranged in a triangle on the front, the anterior one smaller; palpi 4 segmented; antennæ 2+15 jointed, almost annular, the apical joint very small. Abdomen with 7 plainly visible segments. Tibiæ with short and slender spurs, lateral setæ of middle and hind tibiæ small. Wing broad (fig 77); subcosta about 1-3 as long as the wing, subcostal crossvein wanting; R_{2+3} arises at the R-M crossvein, R_{4+5} ends near the tip of the wing, the costa is prolonged a little beyond it, the media arises apparently at the M-Cu crossvein, though there is usually an indication of the true basal section of this vein in the form of a fold-like vein bisecting the basal cell; the cubitus forks slightly proximad of of M-Cu crossvein, anal vein ends in the margin of the wing.

Mycetobia divergens Walker.

1856. *divergens* Walker. Insecta Saundersiana, Dipt. I. 418.
1867. *persicæ* Riley, Prairie Farmer 15 June. vol. 35. n. s., V. 19, p. 397 (Mycetophila).
1869. *sordida* Packard, Guide to study of Insects. 388.
1903. *marginalis* Adams, Kansas Univ. Science Bulletin II. 2. 21.

Male and female. Length 3 to 4 mm. Head black, subshining, tip of palpi yellow; antennæ black including the basal joints. Mesonotum black, shining, humeri, lateral and posterior margins, and scutellum with a reddish tinge, pile yellow, pleura and metanotum black, mostly shining. Abdomen variable, shining, basal segments usually more or less yellow, apical segments blackish, pile yellow. Legs yellow, tarsi infuscated at the tip, fore metatarsus 2-3 as long as its fore tibia. Wings hyaline, subcosta ends in the costa proximad of the base of R_{2+3}; venation as figured (fig. 77). Length of wing 3 to 4 mm. which is 3 1-3 times as long as the fore tibia. Halteres yellowish. Ithaca, N. Y.; Boulder, Col. (T. D. A. Cockerell, collector); Gardiner, Maine.

In my specimens there is considerable variation in the amount of color on the abdomen, in other respects they appear identical. This variation has led me to believe that the synonymy given above is correct.

Larva. Slender, legless, resembling the larva of an aquatic Ceratopogon, 12 segmented. Head yellowish brown, oblong, about twice as long as wide; labrum with rounded margin, setose ventrally; mandibles when extended, reach cephalad of margin of labrum, brown in color, apical half oval, margined with a number of blunt teeth, mesal margin also with toothed hook produced cephalad, maxilla fleshy, its palpus short, papillate; hypopharynx setose; labium with brown margin, and with 2 pointed teeth on lateral cephalic margin; a few scattered setæ on head; 2 eye spots. Body hyaline, whitish, the 2 main tracheal trunks open on the center of the lateral margin of the first thoracic segment and extend to the apex of the twelfth abdominal segment; they are connected by a strong commissure at the cephalic end of the second thoracic segment. At the posterior end the spiracles are surrounded by a fringe of setæ which project out at right angles to the axis of the body. Length of full grown larva about 7 mm.

Pupa. Brown; tapering, with a few caudad projecting spines from the thorax and each of the abdominal segments. Length 4 mm.

Habit. This species has been reported a number of times by fruit growers as causing injury to the roots of apple and peach trees. It has been found to occur in the rotting wood of these trees but it is extremely doubtful if it is able to cause injury to the sound wood. Both Riley and Walsh as well as Glover have recorded it and all are agreed as to the inoffensive character of this insect. The specimens upon which the above descriptions were drawn, were sent to me by Mr. Gardiner, of Gardiner, Maine.

2. Genus *Palæoplatyura* Meunier.

Palæoplatyura Meunier, Miscell. Entomol. VII. 164. 1899.

Head depressed, front broad, ocelli 3 in number remote from eye margin, palpi 4 jointed; antennæ 2+14 jointed, about as long as head and thorax taken together. Thorax arched, setæ not prominent; abdomen of the male with 7 visible segments; hypopygium small, consisting of a pair of 2 jointed forceps, the basal joint stout, the terminal joint curved, about 4 times as long as broad, the apex toothed and densely ciliated on the inner side. Legs slender, tibial spurs about 1.5 times as long

as the diameter of the femur at the widest part; tarsal claws toothed, empodium prominent. Wings (fig. 78) broad, longer than the abdomen; costa produced beyond the tip of $R_{1}+_{5}$, almost reaching the tip of the wing; subcosta less than 1-3 the length of the wing, ending in the costa a little beyond the point where the radial sector begins; subcostal crossvein present or absent; R_{1} ends about 2-3 the length of the wing, $R_{2}+_{3}$ about as long as basal section of the radial sector and ends a little beyond the tip of R_{1}, the R-M crossvein stout and very short, the media arises near the base of the wing and is represented by a delicate fold-like vein to the crossvein, beyond which it is strong, and forks about half way from the crossvein to the base of $R_{2}+_{3}$; cubitus forks slightly proximad of the M-Cu crossvein; second anal vein may be produced to margin or may be abbreviated. Contains recent as well as fossil forms.

Table of species.

a. Wing immaculate; subcostal crossvein absent, anal vein not reaching margin of the wing. 1. *aldrichii.*

aa. Wing with markings; subcostal crossvein present, anal vein reaches margin of wing. (fig. 78) 2. *johnsoni* n. sp.

1. *Palæoplatyura aldrichii* Johannsen.

1909. *aldrichii* Johannsen, Genera Insectorum, Mycetophilidæ. 10.

Male. Length 4 mm. Head, face and antennæ fuscous, basal joint of the last and palpi yellow; ocelli arranged in a triangle. Thorax pale brownish, including pleura, sternum and scutellum, the mesonotum with 3 confluent darker stripes, metanotum dark brown, humeri and supra-pleural stripe yellow; black setæ arranged in 5 longitudinal lines, 3 on the mesonotum and 2 on the lateral margin; scutellar setæ fine and numerous, but little longer than those on the humeri. Abdomen brown, darker apically, with black setulæ; hypopygium as described for the genus. Coxæ and legs pale yellow, tarsi infuscated, fore metatarsus about .7 as long as its tibia; spurs yellow. Wings hyaline, with a very faint smoky tinge, heavier veins brown, slender veins more yellowish; subcostal crossvein wanting, anal vein stout but not reaching margin of the wing. Halteres yellow.

One specimen from Professor Aldrich. Friday Harbor, Wash. This species differs in several important structural characters from the following, though for the present they will be left in the same genus.

2. *Palæoplatyura johnsoni* n. sp.

Male. Length 5 mm. Head subshining black; ocelli in a transverse line set low on the front, the median one smaller than the laterals. Face fuscous, oval margin produced and covered with erect black setæ; labellæ and palpi yellow, both of medium size, the latter with 4 joints of which the first and second are subequal, the third about thrice, the fourth 4 times as long as the first, all with a few black setæ, those of the fourth small and inconspicuous; the scape yellow, the basal joints of the flagellum yellowish, the remaining joints fuscous; first flagellar joint about twice as long as wide, the other joints but little longer than their width; whole antenna if bent back would scarcely reach the metanotum. Mesonotum shining yellow with 3 brown stripes, the middle one widest, setæ black, sparse, not arranged in longitudinal rows; scutullum yellow, without prominent setæ; metanotum and pleura except at base of the wing, brown. Abdomen brown, the apical margin of the segments, except of the first, yellow; setæ black. Posterior end and hypopygium crushed in the single specimen, hence cannot be described. Coxæ and legs yellow, tarsi more dusky, fore metatarsus slightly longer than its tibia, setæ of middle and hind tibiæ small and inconspicuous, shorter than the diameter of the tibia; one spur on fore tibia, 2 subequal ones on each of middle and hind tibiæ; empodium consists of a few short setæ, the claws each with 2 short, stout, straight teeth proximad of the middle. Wings (fig. 78) grayish hyaline with markings as follows: an oval brown spot covering the R—M crossvein and extending distad to beyond the fork of the media with a tiny hyaline spot in it just distad of the crossvein; a small brown spot at costal margin and filling the space between R_{2+3} and apex of R_1; an elongate spot covering the apical end of Cu_2 and faintly merging into the posterior end of the subapical brown band which arises on the costa between the extremities of the branches of the radial sector and extends posteriorly more

faintly over the branches of the media and beyond the anterior branch of the cubitus where it nearly or quite reaches the wing margin; subcosta ends in the costa well beyond base of the radial sector, the subcostal crossvein is situated half way between the humeral crossvein and the base of the radial sector; R_{2+3} arises before the apex of R_1 but ends well beyond its tip; the costa is produced well beyond the tip of R_{4+5} but does not reach the tip of the wing; the anal vein is produced to the wing margin; the apical end of the first section of the radial sector and of the media hyaline white, the remainder of the veins brown, the heavier veins darkest. Length of wing 6 mm. One specimen from Burlington, Vt. taken in June by Mr. C. W. Johnson.

3. Genus *Ditomyia* Winnertz.

Ditomyia Winnertz, Stett. Ent. Zeit, VII, 14. 3. 1846.

Head spherical, flattened in front; 3 ocelli, unequal, in a transverse line; palpi 4 jointed; antennæ 2+15 jointed, the last very small, papilliform. Abdomen with 7 visible segments. Legs long and slender, tibiæ with short spurs. Wings (fig. 80) large, hairy, subcostal vein short, incomplete; R_{2+3} arises proximad of the fork of the media; media arises apparently at the R—M crossvein, the basal section having been wholly obliterated; cubitus forks slightly proximad of the M—Cu crossvein; anal vein prolonged to the margin.

Ditomyia euzona Loew.

1869. *euzona* Loew, Berl. Ent. Zeitschr. XIII. 1.

Male. Length 6 mm. Head, scape, and base of first flagellar joint yellowish, flagellum and palpi blackish. Thorax yellow, dorsum with dusky vittæ; scutellum except the base, fuscous. Abdomen yellow, each segment with a black posterior fascia which is dilated in the middle and on the lateral margins, hypopygium dusky. Coxæ and legs yellowish. Wings hyaline, grayish tinged, with the following fuscous fasciæ; the first near the base of the wing extends from the costa into the basal cell R, the second extends across the wing from near the apex of the subcostal cell to the posterior branch of the cubitus; the third widely covers the apex of the wing. Length of wing 6.2 mm. Halteres yellow.

The type, from the District of Columbia, is now in the museum at Cambridge, Mass. Another specimen of this beautiful species is in the United States National Museum.

4. Genus *Symmerus* Walker.

Symmerus Walker, List Dipt. Brit. Mus. I. 88. 1848.

Plesiastina Winnertz, Stett. Ent. Zeit. XIII. 55. 4. 1852.

Head, antennæ, palpi, abdomen and legs as with Ditomyia. Eyes somewhat approximated on the vertex, ocelli 3 in number. Fore tibiæ on inner side with several slender setæ, the hind pairs as with Ditomyia. Wing venation (fig. 81) as with Ditomyia but differs primarily in having a shorter R_{2+3}, the base of which is somewhat distad of the fork of the media, and the costa ends at the tip of R_{4+5}.

Table of species.

a. Thorax shining fuscous black; abdomen and halteres mainly black, the basal half of peduncle of the latter, yellow; length 5 mm. Eastern states. 1. *tristis.*

aa. Thorax and usually halteres also, mainly yellow.

b. Wings distinctly fasciate.

c. Wing with a single slender fascia across the cross-veins; abdomen black, segments with yellow posterior margins; length 12 mm. Mexico. 2. *lenis* n. n.

cc. Wing with two transverse fascia.

d. Thorax with 3 shining black stripes; legs mainly yellow, hind femora, tip of hind tibiæ, hind tarsi and tip of middle tibia, black, 6½-7 mm. Mexico. 3. *bifasciata.*

dd. Thorax yellow, reddish in the middle; legs pale, tarsi fuscous; length 10 mm. Mexico. 4. *mexicana.*

bb. Wings not distinctly fasciate.

c. Thorax shining yellow, abdomen yellow, segments with wide, black posterior margins; length 7-7½ mm. Eastern States. 5. *annulata.*

cc. Thorax yellow with blackish median fascia; dorsum of abdomen black, the segments with pale margins; length 4.5-6 mm. New York. 6. *lauta.*

1. *Symmerus tristis* Loew.

1869. *tristis* Loew, Berl. Ent. Zeitschr. XIII. 131. 2. (Plesiastina).

Female. Length 4.5 to 5 mm. Head fuscous black, vertex and flagellum of the antenna more purely black. Thorax shining fuscous black, pleura and metanotum a little paler. Abdomen blackish, with black pile, the apical segment and appendages yellowish. Legs and coxæ fuscous, trochanters and the knees pale. Wings (fig. 81) smoky, the petiole of the media shorter than its anterior branch. Halteres black, stem yellow at base. D. C. (Osten Sacken); Massachusetts (W. M. Wheeler, col.).

2. *Symmerus lenis* n. n. (not *zonata* Stephens).

1890. *zonata* Giglio-Tos, Boll. Mus. Anat. comp. Torino. V. No. 84. (Ditomyia).

Male. Length about 12 mm. Face, front and palpi pale yellow; eyes black, pubescent; 3 ocelli arranged in a transverse row upon a black spot; antennæ yellow, longer than the head and thorax combined, the 6 apical joints black. Thorax yellow, with yellow pile, with 3 vittæ confluent posteriorly; pectus and metathorax black; scutellum yellow. Abdomen black, pilose, the first segment wholly and posterior margins of the others yellow. Legs yellow, hind femora fuscous at the base; the tips of tibiæ and tarsi blackish. Wing slender, longer than the abdomen, with a slender subfuscous transverse fascia which extends from R_1 across the crossvein nearly to the posterior margin of the wing following here the course of Cu_2. Halteres yellow.

Female. Smaller; antennæ wholly testaceous, shorter. Abdomen sparsely pilose. Recorded from Orizaba, Mexico, by Giglio-Tos.

3. *Symmerus bifasciata* Williston.

1900. *bifasciata* Williston, Biol. Centr.-Amer. I. 217. (Plesiastina).

Male. Length 6½-7 mm. Head yellow, the ocelli on small blackish spots; antennæ longer than the head and thorax together, light yellow, the last seven joints black, the flagellum flattened. Mesonotum light yellow, with three broad shining

black stripes, the lateral ones abbreviated in front. Scutellum yellow, with the margin brownish. Pleura in part pitchy brown. Metanotum light yellow above, brown on the lower part. Abdomen: first segment and the venter light yellow; second to seventh segments, inclusive, shining black, with the hind margin yellow or yellowish, and clothed with yellow hair; remainder of abdomen black, with less abundant yellow hair; hypopygium yellow, with the superior organs blackish. Legs yellow; 4 posterior coxæ brownish; hind femora, tip of the hind tibiæ, the hind tarsi, and the tip of the middle tibiæ black; middle tarsi brownish; front tibiæ with weaker bristles; all the tibiæ with spurs, the hind pair with long and stout ones. Wings light yellow, with brown markings as follows: the whole of the costal cell, except sometimes a spot at the beginning of the yellow distally, the broad distal and narrow posterior margin, and a moderately broad band near the middle of the wing; the subcostal vein vanishes in a fold that ends about opposite the beginning of the radial sector; the radial sector forks before its middle, the media a little beyond the middle of the petiole of the radial sector; the costal vein ends at the tip of R_4+_5. Mexico, Sierra de las Aguas Escondidas in Guerrero, 7000 feet.

4. *Symmerus mexicana* Giglio-Tos.

1890. *mexicana* Giglio-Tos, Boll. Mus. Zool. Anat. Comp. Torino. V. No. 84. (Ditomyia).

Male. Length 10 mm. Face and front yellow; eyes black, 3 ocelli, distant, placed in a right line upon a black spot; antennæ yellow, subfuscous toward the tip, longer than the head and thorax conjointly. Thorax yellow, reddish upon the center of the mesonotum. Abdomen black, with yellow pile, subclavate posteriorly, the whole of the first, and the posterior margins of the second and third, yellowish. Legs yellow, tarsi fuscous, each tibia with fuscous apex. Wings yellow, sparsely tomentose; longer than the abdomen, with 2 fuscous fasciæ, the first filling the basal half of the costal cell and extending across the disk of wing between the crossveins and the base of the fork of the media; the second broadly covers the apex of the wing. Halteres yellow. Recorded by Giglio-Tos from Orizaba, Mexico.

5. *Symmerus annulata* Meigen.

1830. *annulata* Meigen, Syst. Beschr. VI. 294. 3. (Plesiastina).

Male and female. Length 7 to 7½ mm. Palpi and face yellow; front and vertex fuscous; antennæ brown, the scape and sometimes the basal flagellar joints yellow. Thorax and abdomen yellow, shining, the latter somewhat compressed, with posterior half or two-thirds of each segment fuscous. Coxæ and legs yellow, tarsi infuscated; fore tibia only slightly longer than the fore metatarsus; all femora ciliated beneath. Wings grayish hyaline, costal cell more ferruginous; veins brown; subcosta a mere tooth. Recorded from New Jersey and New Hampshire.

6. *Symmerus lauta* Loew.

1869. *lauta* Loew, Berl. Ent. Zeitschr. XIII. 132. 3. (Plesiastina).

Male. Length 4½ to 6 mm. Pale yellow. Flagellum of antenna fuscous black; vertex in large part black. Mesonotum shining with 3 black vittæ, the median vitta paler anteriorly and divided by pale line; pleura immaculate. Tergum of each abdominal sclerite blackish with pale anterior and posterior margins, venter wholly pale yellow; hypopygium brownish, stout, superior forceps black, shorter than the inferior forceps. Legs pale yellow, tibial spurs black, tarsi infuscated. Wing tinted with cinereous; petiole of the media and M_2 subequal. Halteres yellow; knob infuscated. Recorded from N. Y. A defective specimen from Ithaca, N. Y., bears the date August 24.

3. Subfamily Diadocidiinæ.

Diadocidinæ. Winnertz. Verh. Zool.-bot. Ges. Wien. XIII. 656. 1863.

This subfamily is distinguished from all others in having the M-Cu crossvein present and at the same time only 2 branches of the radius.

Genus *Diadocidia* Ruthe.

Diadocidia Ruthe, Isis. II. 1210. 1831.

Macroneura, Macquart, Suites à Buffon I. 146. 1834.

Head rounded, flattened in front; ocelli, 3, subequal, in a triangle on the front; palpi 4 jointed; antennæ 2+15 jointed, the apical joint papilliform. Thorax ovate, arched. Abdomen with 7 visible segments. Legs slender, femora somewhat thickened; hind tibiæ with 3 rows of delicate setæ. Wings (fig. 91) hairy, large, with wide base; subcostal vein, long and ends in the costa; subcostal crossvein (Sc_2) present or absent; R_1 ending in the costa distad of the mid length of the wing; the radial sector unbranched and ending in the costa before its tip; second anal produced to the wing margin.

Table of species.

a. Recent species.
   b. Subcostal crossvein wanting; apex of R_1 far proximad of tip of Cu_1. Eastern States. 1. *ferruginosa.*
   bb. Subcostal crossvein present; apex of R_1 opposite the tip of Cu_1. B. C. 2. *borealis.*
aa. Fossil species. Colorado. *terricola.*

1. *Diadocidia ferruginosa* Meigen.

1830. *ferruginosa* Meigen, Syst. Beschr. VI. 294. 4. (Mycetobia)
1831. *flavicans* Ruthe, Isis, II, 1211 (Diadocidia).
1834. *Winthemi* Macquart, Suites à Buffon. I. 147. 34. (Macroneura).

Male and female. Length 3 mm. Front, vertex, face and antennæ brown, base of the last and proboscis and palpi yellow. Thorax yellow, with 3 subcoalescent brown stripes, wanting in immature specimens; scutellum yellow; metanotum brown. Abdomen sordidly yellowish, darker apically. Legs yellow, tarsi infuscated; fore metatarsus nearly 2-3 as long as its tibia, hind tibia longer than the tarsus. Wing (Fig. 91) tinged with gray, with pale brown veins and gray setulæ; subcostal crossvein wanting. Halteres yellow. Ithaca, N. Y., August 10; Auburndale, Mass., July 16, (C. W. Johnson). Has also been recorded from the White Mountains, New Hampshire.

2. *Diadocidia borealis* Coquillett.

1900. *borealis* Coquillett, Proc. Wash. Acad. Sciences. II. 390.

Male. Length 4 mm. Head and antennæ dark brown, two basal joints of the latter, also the proboscis and palpi, yellow; thorax polished, yellow, the dorsum, except the front corners, dark brown; scutellum yellow; metanotum brown; abdomen dark brown, slightly polished, its hairs yellowish; coxæ and femora light yellow, tibiæ and tarsi brown, front tarsi slender; knob of halteres yellowish brown; wings hyaline, densely covered with short hairs, subcostal crossvein present, tip of R_1 about opposite apex of anterior branch of the cubitus. Lowe Inlet. B. C.

4. Subfamily CEROPLATINÆ.

Ceroplatinæ, Winnertz. Verh. Zool.—bot. Ges. Wien. XIII. 684. 1863.

The primary distinction possessed by the members of this subfamily is found in the wing venation. The R—M crossvein is obliterated by the coalescence of a section of the basal portion of the radius and media at the point where the crossvein usually is. The antennæ are short, usually thickened, and often more or less flattened.

Table of Genera.

a. Face and proboscis prolonged, beak-like or snout-like. (figs. 46, 49 and 87). 1. *Asindulum.*

aa. Proboscis short, not beak-like.

b. Antennæ very much flattened, strap-like; palpi porrect, not incurved (figs. 47, 48).

c. R_2+_3 ends in R_1 (fig. 82). 2. *Ceroplatus.*

cc. R_2+_3 ends in the costa (fig. 83). 3. *Cerotelion.*

bb. Antennæ not conspicuously flattened, palpi incurved, and moderately elongate.

c. Media arises at the base of the wing, basal section may be delicate and fold-like.

d. R_2+_3 ends in the costa (fig. 89). 4. *Hesperodes.*

dd. R_2+_3 ends in R_1 (fig. 88). 5. *Apemon.*

cc. Media apparently arises at the crossveins; i. e., its basal section wanting (figs. 84, 85, 86). 6. *Platyura.*

1. Genus *Asindulum Latreille.*

Asindulum. Latreille, Hist. Nat. Crust. Ins. XIV. 290. 1805.

Head transversely oval; middle ocellus smaller than the laterals; proboscis much elongated, deeply cleft (figs. 46, 49), palpi 4 jointed, incurved; antennæ 2—15 jointed, apical joint small, papilliform. Thorax arched; abdomen with 8 visible segments. Legs slender, the femora, particularly the hind pair, stout, the tibiæ with spurs and with delicate lateral setæ. Venation (fig. 87) as figured, resembling that of *Platyura.*

Table of species.

a. Length 8 to 8½ mm.; abdomen with the first 3 segments black, the remaining ones more or less yellow. N. Y., N. H., S. D. 1. *montanum.*

aa. Length about 5mm.

b. Abdomen wholly and thorax mainly black; fore metatarsus .8 as long as its tibia. Canada. 2. *coxale.*

bb. Abdomen and thorax more or less yellow. New Hampshire. 3. *flavum.*

1. *Asindulum montanum* Rœder.

1887. *montanum* Rœder, Wien. Ent. Zeit. VI. 116.

Male and female. Length 8 to 8½ mm. Black, epistome yellow, proboscis (fig. 46) black, antennæ fuscous-black. Thorax of the male black with yellow humeral angle and pleura; of the female and immature males yellow with three black longitudinal stripes; scutellum yellowish, often infuscated. The first three abdominal segments black, the remaining ones yellow though not infrequently more or less infuscated. Hypopygium yellowish brown; the inferior forceps lamelliform. Legs yellow, fore metatarsus ¾ as long as its tibia. Wings (fig. 87) hyaline; apically especially on costal margin somewhat smoky. Halteres yellow. White Mountains, N. H. (Cornell University collection); Adirondack Mountains, N. Y.; and S. D. (Aldrich).

2. *Asindulum coxale* Loew.

1869. *coxale*, Loew. Berl. Ent. Zeitschr. XIII. 132. 4.

Male. Length 5 mm. Black, including head, antennæ, proboscis (fig. 49) and body pile. Anterior part of lateral margin

of the mesonotum narrowly yellowish as well as the sides of the scutellum. Abdomen and hypopygium black, the superior forceps slender, the inferior pair broad, neither very prominent. Coxæ and legs yellow, trochanters, tibial spurs and tarsi blackish; fore metatarsus .8 as long as its tibia. Wing subhyaline, slightly more cinereous apically. Halteres yellowish, knob fuscous above.. Recorded from Hudson Bay Territory. I have a specimen from Montreal.

3. *Asindulum flavum* Winnertz.

1846. *flavum* Winnertz, Stett. Ent. Zeit. VII. 17. (Macrorrhyncha).

Male and female. Length 4 to 5½ mm. Face, epistome, labellæ, lower front, base of antennæ, and occiput yellow; proboscis and remaining parts of the head black. Thorax yellow with 3 pale brown, sometimes obsolescent, stripes; scutellum with black hairs. Abdomen of the male with basal segments yellow, apical segments brown to black, hypopygium black; of the female yellow, anterior margin of each segment with a brown transverse fascia, terminal segments usually black; in immature specimens the fascia are obsolete. Coxæ and femora pale yellow; tibiæ pale brown; tarsi, spurs and setæ of tibiæ, brown; fore metatarsus ¾ as long as its tibia. Wing yellowish. Halteres whitish. The larvæ have been found in decaying wood. I have seen a specimen from New Hampshire.

2. Genus *Ceroplatus* Bosc.

Ceroplatus, Bosc. Act. Soc. Hist. Nat. Paris I. 1. 42. 1792.

Head small, ovate; three ocelli arranged in a transverse curved line; palpi (fig. 47) not incurved, 3 or 4 jointed; antennæ shorter than head and thorax taken together, very broad and flat, compressed, strap-like, 2+14 joints, the intermediate joints much broader than long (fig. 48). Thorax ovate; abdomen with 7 visible segments. Legs long, lateral setæ of tibiæ either absent or very minute. Wings (fig. 82) shorter than the abdomen; costa produced beyond the tip of R_{1+3} but ending before the tip of the wing; subcosta ends in the costa; subcostal crossvein, when present, basal in position; R_{2+3} ends in R_1; media with a short petiole; anal vein produced to the wing margin.

Table of species.

a. Thorax and abdomen black, lateral margin of abdominal segments whitish; wing with black mark; length 10 mm. Carolina. 1. *carbonarius.*

aa. Thorax more or less yellow.

b. Abdomen nearly entirely yellow; coalesced part of the media longer than the petiole. 2. *terminalis.*

bb. Abdomen with distinct brown markings.

c. Coalesced part of the media about equal to the length of the petiole; dark spot near apex of wing; abdominal segments more than half yellow. 3. *clausus.*

cc. Coalesced part of the media about twice the length of the petiole; no spot near apex of wing in male, and only feebly indicated in the female; yellow of abdomen confined to apical third of each segment. 4. *militaris.*

1. *Ceroplatus carbonarius* Bosc.

1802-4. *carbonarius* Bosc, Nouv. Dict. Nat. Hist. IV. 543.

Length 10 mm. Head black; thorax black, smooth; abdomen elongate, cylindrical, black, the lateral margins of each segment white; wing hyaline with black apex; legs dusky. Carolina.

2. *Ceroplatus terminalis* Coquillett.

1905. *terminalis* Coquillett. Journ. N. Y. Ent. Soc. XIII. 69.

Male. Length 9-10 mm. Light yellow; claws and ocellar area, black; vertex, a fine median line and 2 pairs of thoracic dorsal stripes of which the inner pair converge posteriorly, longitudinal pleural stripes, sternum, median spot on scutellum, lateral spots on first abdominal segment, knob of halteres, spot on sides of middle and hind coxæ and their apices, antennæ and forceps more or less brown. Antennæ more dusky yellow than the remaining parts. Inferior tubercle of the first antennal joint subconical, over half as long as the diameter of the second segment. Thoracic and abdominal setæ black. Wings hyaline, veins yellowish brown, an oval yellowish cloud over R_{2+3} extending into the adjacent cells, subcostal crossvein present;

coalesced part of the media a little longer than the petiole. Tibiæ and tarsi appear infuscated because of the longitudinal rows of the black setulæ; metatarsi of middle and hind legs sparsely ciliate on flexor surface with short setæ. Described from a specimen from the Western states. The species was recorded from Kaslo, British Columbia, by Mr. Coquillett.

3. *Ceroplatus clausus* Coquillett.

1901. *clausus*, Coquillett, Proc. U. S. Nat. Mus. XXIII. 594.

Male and female. Length 7 to 8 mm. Yellow, upper part of head brownish yellow, a black ocellar dot, the antennæ, 4 indistinct vittæ on mesonotum, 1 or 2 spots on pleura, a fascia at base of each segment of abdomen and knobs of halteres brown; antennæ greatly compressed, the joints except last one wider than long; wings (fig. 82) hyaline, a grayish brown spot fills the cell R_{2+3} and encroaches on the adjoining cells; subcostal vein extends considerably beyond the base of the radial sector; subcostal crossvein close to the humeral, R_{2+3} ends in R_1 at about its length before the apex of the latter, costa scarcely extending beyond the apex of R_{4+5}, cubitus forks considerably beyond the base of the radial sector. Recorded from New Hampshire and New Jersey by Coquillett. I have specimens from Ithaca, New York.

4. *Ceroplatus militaris* n. sp.

Male. Length 8 mm. Face, palpi, posterior margin of eye, and narrow space over base of antennæ, yellow; vertex posterior part of head, antennæ, and a slender streak between antennæ brown; ocellæ area black; basal joint of antenna with tubercle below. Thorax mainly yellow, with 6 dark brown longitudinal stripes, the median pair meeting posteriorly and produced upon the scutellum, sometimes a slender median line between this pair, the latter sometimes connected by a transverse stripe anteriorly; the first laterals somewhat broader than the median pair; the second laterals on the margin of the mesonotum, narrow, and sometimes interrupted, usually reaching the base of the wing, pleura with large brown spot, sternum and margin of the prominent pteropleural lobes infuscated; scutellum and metanotum yellow. Setæ on thorax short, black and sparse; those on

mesonotum and scutellum rather more conspicuous. Anterior 2-3 of each tergum brown, posterior third yellow, venter mainly yellow, seventh segment nearly wholly brown, terminal segment yellowish; abdominal setæ short, black, those on posterior margin of first ventral segment most conspicuous; the forceps which are pale yellow consist of 2 small conical lobes. Coxæ and legs pale yellow, extreme tips of coxæ and immediate bases of femora brown, second and third coxæ sometimes with a brown spot near middle; tibiæ and tarsi appear infuscated due to the fine, black setulæ which are arranged in longitudinal rows; metatarsi of middle and hind legs, sparsely ciliate with small setæ which are less than half as long as the diameter of the metatarsus. Wings hyaline, faintly smoky, the cell R_{2+3} somewhat more dusky, veins brown; subcostal crossvein present, basal in position; coalesced part of the media about twice as long as the petiole. Halteres yellow with brown knob. Ithaca, New York. Specimens also from Intervale, N. H. (G. M. Allen); Philadelphia (C. W. Johnson).

A female specimen from Philadelphia differs in having a suggestion of a black cloud on apex of the wing and abdomen with greater extent of brown fasciæ.

3. Genus *Cerotelion* Rondani.

Cerotelion, Rondani, Dipt. Ital. Prodromus, I. 191. 2. 1856.

This genus possesses the characters of *Ceroplatus* but differs in having the anterior branch of the radial sector R_{2+3} ending in the costa instead of in R_1 (fig. 83). As far as known the subcostal crossvein is absent and the claws have only 1 or 2 basal teeth.

Table of Species.

a. Thorax spotless, reddish yellow, pleura yellow; abdomen reddish yellow, base of basal segments and the whole of the apical segments black. Length 3.7 mm. Kansas. 1. *apicalis.*

aa. Thorax with stripes.

b. Fore metatarsus a little longer than its tibia. Length 5 mm. Mexico, Pennsylvania. 2. *bellulus.*

bb. Fore metatarsus 2.5 times as long as its tibia. Length 6 mm. St. Vincent. 3. *longimanus.*

1. *Cerotelion apicalis* Adams.

1903. *apicalis,* Adams, Kans. Univ. Science Bull. II. 2. 22. (Ceroplatus).

Male. Length 3.7 mm. Head brownish, anterior part of front, 2 basal joints of antennæ, face and mouth-parts yellow; thorax immaculate, reddish yellow, the black pile very short, except on the sides, pleura light yellow, halteres with knobs slightly infuscated; abdomen reddish yellow, base of second, third, fourth, and remainder of apex wholly black; legs light yellow, apical half of tibiæ and tarsi wholly blackish; wings hyaline; smoky towards apex, subcostal vein ends in the costa about midway between humeral crossvein and base of the radial sector, R_{2+3} ends in costa about midway between tip of R_1 and apex of R_{4+5}, furcation of cubitus almost opposite base of radial sector. Kas.

2. *Cerotelion bellulus* Williston.

1900. *bellulus,* Williston, Biol. Centr. Amer. I. 219 (Ceroplatus).

Male. Length 5 mm. Head black, the narrow face and the palpi brownish. Antennæ brownish-black, the first 2 joints somewhat yellowish; flagellum broad and flattened, about twice the length of the head. Mesonotum not shining, brownish in color; in the middle with 2 coalescent stripes, terminating acutely behind and separated from a moderately broad oblique stripe of the same color on each side by a slender V-shaped brown marking. Pleura light yellow along the noto-pleural suture and below the root of the wing, brown elsewhere. Scutellum brownish. Metanotum yellowish. Halteres blackish, with a yellow stem. Abdomen brown, blackish at the tip; the anterior part of the fourth and fifth segments yellow. Coxæ yellow, the distal half of the 2 posterior pairs brown; femora yellow; tibiæ and tarsi brownish. The tibiæ without bristles. Wings (fig. 83) tinged with brownish; subcostal vein strong, not connected with R_1; the radial sector arising about opposite the middle of the distance between the humeral crossvein and the tip of the subcostal vein, R_{2+3} oblique, terminating a little distance beyond the tip of R_1, the costal section intervening not as long as R_{2+3}; the costal vein extends a little distance

beyond the tip of R_{4+5}; prefurca of the media nearly as long as the first section of the radial sector. Mexico, Teapa in Tabasco.

In Williston's figure the palpi appear incurved, this, however, may be the engraver's error. I have a specimen from Pottstown, Pa. (collected by C. W. Johnson) in which the face and palpi are yellow; the coalesced part of the media is but little more than half as long as the petiole; and each claw has a tooth near the base.

3. *Cerotelion longimanus* Williston.

1896. *longimanus,* Williston. Trans. Ent. Soc. Lond. 258 (Ceroplatus)

Male. Length 6 mm. Face yellow, very narrow. Palpi and first 2 joints of the antennæ yellow; remainder of the antennæ dark brown. Antennæ about as long as the dorsum of the thorax. Front narrow, the sides gently convex, black, except on the lowermost portion; the 2 large ocelli about equidistant from each other and from the margins of the eyes. Occiput black. Thorax yellow; the dorsum with 3 broad black stripes, enclosing 2 narrow yellow stripes, which are convergent posteriorly; the median stripe enclosing a slender yellow stripe, which does not reach beyond the middle; a large rounded spot on the mesopleura, another below it on the mesosternum, and the sides of the metanotum, dark brown or black, the middle of the metanotum brownish; scutellum brown. Abdomen slender, cylindrical, dark brown; each segment, save the first and last, with an elongate yellow spot on each side, reaching 2-3 of the way to the hind margin; genital organs yellow. Coxæ light yellow, the hind pair with a brown spot; femora yellow, the base of the middle and hind pairs brown; tibiæ yellowish-brown; tarsi brown; no bristles on the front femora; front metatarsi about 2.5 times the length of the tibiæ; middle metatarsi a fourth or a third longer than the tibiæ; the hind pair scarcely longer; hind tibiæ with two spurs. Wings tinged with brownish; R_{2+3} runs into the costa. St. Vincent Isl., 1000 feet.

4. Genus *Hesperodes* Coquillett.

Hesperodes Coquillett, Entomol. News. XI. 429. 1900.

Subcosta (fig. 89, diagrammatic) ends in the costa beyond the base of the radial sector; the subcostal crossvein is nearly midway between the humeral crossvein and the base of the radial sector, the latter forks beyond the apex of R_5; the media originates near the base of the wing and just before the union with the radial sector connected by the crossvein with Cu, and forking a short distance beyond the union with the radius; cubitus forking midway between the base of the radial sector and its union with the media; anal vein prolonged to the wing margin. Antennæ about twice as long as the head and thorax united, cylindrical but tapering to the apex; 2+14 jointed, the first joint as broad as long, the second twice as broad as long, and the others twice as long as broad; proboscis very robust, shorter than the height of the head; palpi 4 jointed, eyes emarginate opposite the antennæ; ocelli wanting. Abdomen slender, more than 3 times as long as the thorax. This genus, while superficially resembling *Hesperinus* in venation is a true Mycetophilid and more closely allied to *Apemon, Platyura,* etc.

Hesperodes johnsoni Coquillett.

1900. *johnsoni,* Coquillett, Entomol. News. XI. 429.

Male. Length 12 mm. Reddish yellow, antennæ and tarsi beyond the base changing to brown, legs destitute of strong lateral bristles, tibial spurs well developed; wings yellowish, becoming grayish hyaline on the posterior margin and at the apex, a brown spot at apex of R_5. Delaware Water Gap, N. J. July.

5. Genus *Apemon* Johannsen.

Apemon, Johannsen, Genera Insectorum, Mycetophilidæ. 20. 1909.

Resembles *Platyura* but differs in having a distinct, though delicate, fold-like basal portion of the media arising near the base of the wing, and in having no setæ, but only fine hairs upon head, thorax, coxæ and femora. The setæ of the abdomen, tibiæ and tarsi very small and inconspicuous. Antennæ 2+14 jointed, flagellar joints cylindrical, under 20 diameter magnifi-

cation only indistinctly pilose; ocelli large, arranged in a transverse line on the broad front, middle one only slightly smaller than the others; eyes pilose; palpi incurved, rather long, basal joint very small, second broad, about as long as broad, third joint about half as broad but twice as long as the second, fourth slender, about 5 times as long as broad; proboscis short. Thorax moderately arched, dorsum and scutellum provided only with hairs, those over the base of the wing and on the scutellum rather longer, pleura and metathorax nearly bare. Abdomen depressed, flattened, broadened apically, segments finely setulose, particularly on basal portion; male genitalia (fig. 97) small, simple, consisting primarily of two incurved lateral lobes, toothed at the apex. Legs moderately long; coxæ long, these and the femora short haired, setulæ of the tibiæ less than ¼ the diameter of tibia in length, spurs strong; fore metatarsus shorter than the tibia; all tarsi finely setulose, claws with teeth near the base of each; empodium conspicuous. Wings (fig. 88) resembling those of *Platyura;* media arises near the base of the wing; its first section is delicate and fold-like; R_{2+3} joins R_1 near its apex; anal vein prominent, produced to the wing margin.

Table of species.

a. Subcosta short, ending at or before the base of the radial sector.
  b. Length 6 mm. Abdomen yellow with anterior portion of each segment black. 1. *gracilis.*
  bb. Length 8 to 12 mm. Abdomen reddish yellow, first segment black; female. 2. *pectoralis.*

aa. Subcosta ends distad of base of radial sector.
  b. Mesonotum and abdomen reddish yellow, pleura, metanotum and first abdominal segment black; male. 2. *pectoralis.*
  bb. Mesonotum black or with brown stripes.
    c. Abdomen in part reddish yellow.
      d. Mesonotum reddish yellow with 3 dark brown stripes; part of third, fourth and fifth abdominal segments yellow, other segments black. 3. *maudæ.*
      dd. Mesonotum black, abdomen yellow, except first 2 segments. 4. *pulchra.*
    cc. Abdomen wholly black. 5. *nigriventris* n sp.

1. *Apemon gracilis* Williston.

1893. *gracilis* Williston, Kas. Univ. Quarterly II. 60 (Platyura).

Male. Length 6 mm. Antennæ black, much shorter than the thorax; first 2 joints yellowish. Head yellow, the vertex blackish. Thorax, coxæ, and femora yellow; the mesonotum more reddish with a fringe of black hairs above the root of the wings. Abdomen slender, not shining; yellow, the anterior portion of each segment brown or blackish. Tibiæ somewhat infuscated by the minute black hairs; tarsi blackish. Wings with a strong yellow or brownish tinge, the extremity with a blackish cloud; subcostal vein very short, terminating before the origin of the radial sector, the subcostal crossvein at about its middle; R_{2+3} at some distance before the tip of R_1; third anal vein wholly wanting. Washington.

2. *Apemon pectoralis* Coquillett.

1895. *pectoralis* Coquillett, Canad. Entomol. XXVII. 199 (Platyura).

Female. Length 12 mm. Front, occiput and antennæ, black; first 2 joints of the latter, the face, cheeks and mouth parts, yellowish. Thorax and scutellum reddish-yellow, pleura and metanotum bluish-black. Abdomen reddish yellow, the first segment black, the second 3 times as long as broad. Halteres yellowish. Coxæ and femora reddish yellow, tibiæ brownish-yellow, tarsi black. Wings yellowish-grey; a brown spot extends from the costa before the tip of R_1 to posterior branch of the media near its base; apex of wing from midway between tips of R_1 and R_{4+5} to apex of anal vein, grayish-brown; a brown cloud on the radial sector near its base; tip of subcostal vein opposite base of the radial sector, subcostal crossvein 1.5 times the length of the humeral beyond the latter; R_{2+3} oblique, ending twice its length before the tip of R_1; anal vein reaches the wing margin. Nevada.

Several male specimens taken by Prof. Aldrich in June at Grangeville and Moscow, Idaho, differ as follows: the brown cloud on apex of wing (fig. 88) less extended; the subcosta ends distad of the base of the radial sector, R_{2+3} is nearly per-

pendicular in position; the fore metatarsus is two-thirds as long as its tibia; hypopygium as figured (fig. 97). One specimen is only 8 mm. long, but otherwise does not differ.

3. *Apemon maudæ* Coquillett.

1895. *maudæ* Coquillett, Canad. Entomol. XXVII. 199 (Platyura).

Female. Length 9 mm. Head and antennæ black, palpi yellowish. Thorax, pleura and scutellum bluish-black. Abdomen reddish-yellow, first 2 segments black, the base of the second tinged with reddish; this segment is half longer than broad. Halteres yellowish. Coxæ reddish-yellow, blackened at their bases, femora deep yellow, tibia brownish-yellow, tarsi black. Wings yellowish-gray, a brownish spot extends from R_1, before its apex, to the posterior branch of the media near its base; apex of the wing from midway between tips of R_1 and R_{4+5} to apex of anal vein grayish-brown; a brown cloud on third vein near its base; tip of subcostal vein twice the length of the humeral crossvein beyond the base of the radial sector; subcostal crossvein 1.5 times the length of the humeral crossvein beyond the latter; R_{2+3} oblique, ending nearly its own length before the tip of R_1; anal vein reaches the wing margin. Male same as the female except the second abdominal segment is twice as long as broad, and R_{2+3} is perpendicular, ending twice its length before tip of R_1. Washington.

4. *Apemon pulchra* Williston.

1893. *pulchra* Williston, Kas. Univ. Quarterly II. 59 (Platyura).

Male. Length 8 to 9 mm. Antennæ about as long as the thorax; black on the under side, toward the base, red; first 2 joints yellow. Front and face black, the latter with whitish pubescence; palpi and proboscis yellow; occiput black; epistome moderately projecting. Mesonotum shining reddish yellow, with light-yellow hair; 3 dark brown stripes, separated by slender lines, the lateral ones abbreviated in front. Scutellum black. Pleura black, with reddish spots; the projecting metapleura yellowish. First 2 segments of the abdomen black; third segment reddish yellow, with a black hind border; fourth

segment and the anterior part of the fifth reddish yellow; remaining segments black; the hypopygium reddish, with whitish pubescence; abdomen shining. Coxæ and legs (the hind pair is wanting) light yellow; tibiæ infuscated by the minute black hair; tarsi blackish; middle and front tibiæ with short spinules. Wings hyaline, the tip and posterior border infuscated; a narrow brown cloud covers the tip of R_1 and reaches into the base of the cell R_{2+3}; subcostal crossvein only a little distance beyond the humeral crossvein; tip of subcostal vein beyond the origin of the radial sector; R_{2+3} terminates in R_1 near its tip; prefurca of media very short. Anal vein complete. Washington.

5. *Apemon nigriventris* n. sp.

Male and female. Length $7\frac{1}{2}$ to $8\frac{1}{2}$ mm. Head, including scape of antennæ, thorax, abdomen including venter, genitalia, and margin of the trochanters subshining black; palpi, coxæ, femora and halteres reddish yellow, tibiæ dull yellow, spurs a little paler, tarsi fuscous. Hairs of thorax, pale yellow, arranged in 3 longitudinal lines and along the lateral margins; hairs on humeri, scattering hairs on venter and hypopygium pale, elsewhere on head, thorax and abdomen black; those on the coxæ and femora pale, on tibiæ and tarsi black, setæ of the former very minute, scarcely differentiated from the hairs. Intermediate antennal joints but little longer than wide. The fore metatarsus of the male 0.75 as long as its tibia, in the female about 0.7; tarsal claws toothed, setose on basal half, empodium brush-like, as long as the claws. Wing of the male very faintly smoky; of the female more distinctly smoky on apical half; veins dark brown; R_{4+5} ends very close to the tip of the costa but noticeably before the apex of the wing; subcosta ends about the length of R_{2+3} distad of the base of the radial sector; the subcostal crossvein is situated about twice its length distad of the humeral crossvein; R_{2+3} makes about a 45° angle and ends in R_1 very close to its apex; petiole of the media is shorter than the coalesced section of the media; the fold-like basal section of this vein is hyaline; anal vein sinuous, and reaches the margin of the wing. Three specimens collected in July by Mr. J. C. Bradley. Selkirk Mts., Rogers Pass. B. C. 4600 ft. altitude; and Prarie Hill, B. C. 5800 ft. altitude.

6. Genus *Platyura* Meigen.

Platyura Meigen. Illiger's Mag. II. 264. 1803; Klass I. 101. 1804. *Zelmira* Meigen. Nouv. Class. Mouches. 16. 1800. (without type).

Head small, ocelli closely approximated, median smallest; palpi 4 jointed; antennæ 2—14 jointed, cylindrical or somewhat compressed, closely sessile. Thorax oval, setose; abdomen with 7 visible segments, depressed apically. Legs long, femora somewhat thickened; tibiæ spurred, setæ very minute. Wings (figs. 84, 85, 86) somewhat broadened, as long or longer than abdomen; costa prolonged beyond the tip of R_{1+5} and ending before the tip of the wing; subcosta ends in the costa, rarely ending free, subcostal crossvein usually present, R_{2+3} very short usually ending in the costa, rarely in R_2; prefurca of media short; anal vein either incomplete or produced to the margin.

Table of species.

a. R_{2+3} ends in R_2; subcostal crossvein wanting (fig. 85); tibiæ each with but one spur. Length 2 mm. West Indies. 1. *parva.*

aa. R_{2+3} ends in the costa, beyond the apex of R_3.

b. Subcostal vein ends noticeably beyond the base of the radial sector.

c. A distinct transverse fascia or band at or near the apex of wing, or wings with several spots.

d. Wing with band; thorax brown, a median stripe on posterior half and sides yellowish, abdomen dusky, bases of segments yellowish, halteres with black knob. Length 10 mm. Washington. 2. *fasciola.*

dd. Wing spotted; length 3 mm. 7. *elegans.*

cc. Apex of wing hyaline or only indistinctly smoky, no band.

d. Apices of abdominal segments black: fore metatarsus longer than its tibia; length 4½ mm. 3. *inops.*

dd. Apices of abdominal segments, yellow.

e. Thoracic vittæ black; fore metatarsus shorter than tibia. 4. *setiger* n. sp.

ee. Thoracic vittæ reddish yellow. Washington State. 5. *lurida.*

bb. Subcostal vein ends opposite or proximad of the base of the radial sector.

c. Wing with several distinct brown spots, tibiæ each with but a single spur.

d. Dorsum black with central stripes, fore metatarsus about equal to tibia in length. West Indies, 6. *pictipennis*.

dd. Thorax opaque brownish black, often with yellow central stripe; sides, pleura and scutellum yellow; fore metatarsus shorter than its tibia. Atlantic States. 7. *elegans*.

cc. Wing with only a single preapical fascia, or wholly uniform in color.

d. Wing without a band or fascia near apex.

e. Mesonotum mainly black or dark brown.

f. Length 2 mm; subcostal crossvein apparently wanting; anal vein not produced to margin; female. Eastern States. 8. *mimula* n. sp.

ff. Length over 3 mm.

g. Subcostal crossvein wanting; thorax and abdomen black; apex of wing smoky; length 6 mm. 9. *melasoma*.

gg. Subcostal crossvein present, situated far proximad of middle of subcosta; anal vein produced to margin.

h. Scutellum, pleura and hind margins of abdominal segments yellow.

i. Metanotum yellow. 10. *pullata*.

ii. Metanotum black; fore metatarsus shorter than tibia. 4. *setiger* n. sp.

hh. Thorax wholly black, except humeral angle and at base of wings; hypopygium small (fig. 92). 11. *nigrita* n. sp.

ee. Predominant color of mesonotum yellow.

f. A blackish spot on the proximal part of hind coxæ and adjacent portion of pleura; abdomen reddish yellow; wing with feebly marked band before the tip; length 8 mm. 12. *notabilis*.

ff. Smaller species differing from the above.

g. R_{2+3} nearly perpendicular to R_{4+5}.

h. Abdomen brownish yellow, with black hair; subcostal vein very short; length 3 to 4 mm. West Indies. 13. *ignobilis.*

hh. Last segment of abdomen black; faint cinereous spot near apex of wing; subcostal vein over two-thirds as long as the basal cell R; length 5 mm. Maine. 14. *fascipennis* var. *sagax* n. var.

gg. R_{2+3} noticeably oblique to R_{4+5}.

h. Length 2 mm; fore metatarsus about half as long as its tibia, male. 8. *mimula* n. sp.

hh. Length over 3 mm.

i. Each tibia with but a single spur; fore metatarsus and its tibia subequal in length; apical margin of abdominal segments black; length 5 to 6 mm. West Indies. 15. *fasciventris.*

ii. Two spurs on each of middle and hind tibiæ.

j. Fore metatarsus about $\frac{5}{6}$ as long as its tibia; coalesced part of the media 2-3 as long as its petiole; anal vein to margin. 16. *moesta* n. sp.

jj. Fore metatarsus at least $\frac{3}{4}$ as long as its tibia.

k. Apex of subcosta as far proximad of the base of the radial sector as the length of the first section of the sector; anal vein to margin; hypopygium with lobe-like forceps (fig. 99). 17. *mendosa.*

kk. Apex of subcosta nearly opposite the base of the radial sector. 18. *mendica.*

dd. Wing with more or less distinct preapical spot or fascia.

e. A blackish spot on proximal part of hind coxæ and adjacent portion of pleura; thorax and abdomen reddish yellow, wing band feeble; length 8 mm. 12. *notabilis.*

ee. Not as above in all particulars.

f. R_{2+3} nearly perpendicular to R_{4+5}.

g. Last abdominal segment wholly fuscous black.

h. Wing spot distinct; length 3.5 mm. Ga. 26. *divaricata.*

hh. Wing spot subobsolete; fore metatarsus is about 0.25 longer than its tibia; length 5 mm. Maine. 14. *fascipennis* var. *sagax,* n. var.

gg. Abdomen dusky.

h. Abdomen of male including last segment slightly dusky; fore metatarsus over 0.4 longer than the tibia; coalesced part of media noticeably longer than the petiole. 19. *subterminalis.*

hh. Fore metatarsus less than .25 longer than the tibia; coalesced part of media shorter or not longer than the petiole; female. 14. *fascipennis.*

ff. R_{2+3} distinctly oblique to R_{4+5}.

g. Subcostal crossvein wanting; blackish species, wing with slight cloud; length 6 mm. 9. *melasoma.*

gg. Subcostal crossvein present.

i. Fore metatarsus longer than its tibia.

j. Fore metatarsus about 1-6 longer than the tibia; subcostal crossvein is near the middle of the subcosta.

k. Coalesced part of media equal to or shorter than the petiole; hypopygium (fig. 98); preapical cloud subobsolete. 20. *diluta.*

kk. Coalesced part of media longer than the petiole; hypopygium (fig. 96). 21. *moerens* n. sp.

jj. Fore metatarsus over a third longer than the tibia; hypopygium (fig. 107).
19. *subterminalis* var. *nexilis* n. var.

ii. Fore metatarsus equal to or shorter than the tibia.

j. Mesonotum mainly yellow; stripes if present, pale, coalesced part of media shorter than the petiole.

k. Anal vein prolonged to margin; hypopygium with lobe-like forceps (fig. 99). 17. *mendosa.*

kk. Anal vein not prolonged to margin; fore metatarsus and tibia subequal; hypopygium robust (fig. 100). 22. *genualis* n. sp.

jj. Mesonotum black or with dark stripes, coalesced part of media usually equal to or greater than the petiole.

k. Fore metatarsus about 1-5 of tibial length shorter than the tibia; subcosta ends about twice the width of the costal cell proximad of the base of the radial sector; length 5-6 mm.
23. *scapularis* n. sp.

kk. Fore metatarsus 0.1 or less shorter than tibia; subcostal vein ends not more than the width of the costal cell proximad of the base of the radial sector; length 8-9 mm.

l. Scape of antennæ and base of some abdominal segments yellowish.
24. *elegantula.*

ll. Scape of antennæ black; abdomen of male mainly black.
25. *tæniata.*

1. *Platyura parva* Williston.

1896. *parva* Williston, Trans. Ent. Soc. London 257.

Male. Length 2½ to 3 mm. Antennæ brownish-yellow, shorter than the thorax. Posterior part of the mesonotum, the

narrow lateral margins, and 3 slender stripes, brown or black; elsewhere the thorax is yellow, save 2 spots on the pleura, and the metanotum for the greater part, which are black. Abdomen cylindrical, black, the venter and immediate base yellowish. Coxæ and legs yellow; the terminal portion of the tibiæ, and the tarsi, brownish; metatarsi about 3/4 of the length of the tibiæ; all the tibiæ with a single spur and without spines. Wings lightly tinged; R_{2+3} enters R_1 near its tip. St. Vincent, Isl.

I have seen a specimen from one of the Lessor Antilles. The ending of R_{2+3} in R_1, the length of the petiole of the media, the absence of the subcostal crossvein (fig. 85) and the possession of but a single spur on each tibia, are characters which combined mark this species as one widely remote from other *Platyura*. It should perhaps be made the type of a new genus.

2. *Platyura fasciola* Coquillett.

1894. *fasciola* Coquillett, Entomol. News. 120 (Ceroplatus).

Female. Length 10 mm. Head including greatly flattened antennæ and large palpi, dark brown; the retracted proboscis, base of the third antennal joint, a small spot beneath each antenna, yellow. Thorax shining brown, a medio-dorsal vitta on posterior half and lateral margins yellow; pleura yellow, a large spot above the middle coxæ and a small one above hind coxæ, dark brown. Scutellum yellow, its base brown, center of metanotum dark brown. Abdomen shining, blackish brown, base of each segment except first, yellow, on second, third and fourth segments prolonged posteriorly is an indistinct dorsal vitta; coxæ and femora yellow, bases of middle and hind femora, and of hind coxæ blackish brown, tibiæ and tarsi brownish yellow. Wings pale yellowish, the apex between tip of R_1 and apex of Cu_1 blackish, apex of Cu_1 bordered with blackish, this color projecting into the cell of Cu_1 near its middle. Apex of subcostal vein far beyond origin of the radial sector, being opposite origin of M. Subcostal crossvein before middle of the distance between humeral crossvein and tip of the subcostal vein; R_{2+3} very oblique, ending in costa beyond apex of R_1. Knob of halteres black. Washington.

3. *Platyura inops* Coquillett.

1901. *inops Coquillett.* Proc. U. S. Nat. Mus. Bul. 23, 594.

Male and female. Length 4.5 mm. Yellow, an ocella dot and apices of abdominal segments black, most extended on the posterior segments, tarsi yellowish brown; antennæ subcylindrical, the third joint noticeably longer than broad; wings hyaline, a grayish brown spot before apex of R_{4+5}; subcostal vein extending a short distance beyond base of radial sector, subcostal crossvein at about 1-6 of distance from the humeral to apex of subcostal vein, R_{2+3} ending in the costa at about 1-3 of distance from apex of R_1 to apex of R_{4+5}, costa extending nearly midway between apices of R_{4+5} and M_1, cubitus forking beyond base of the radial sector. Delaware Water Gap, New Jersey.

One of each sex from Brattleboro, Vermont, taken in July by Mr. C. W. Johnson, and a single specimen from Ithaca, N. Y., have the coalesced part of the media much shorter than the petiole; fore claws with 2 basal teeth each, one of the teeth slender and about 1-3 as long as the claw; the fore metatarsus 1.5 times as long as its tibia; the hypopygium as figured (fig. 101).

4. *Platyura setiger* n. sp.

Male. Length 5½ mm. Head black, subopaque, palpi and mouth parts, and whole of the antennæ fuscous; intermediate antennal joints about as long as broad. Thorax subopaque, mesonotum with three wide confluent black stripes (in one specimen not confluent), the humeri, lateral stripe to base of wings, and margin of scutellum yellow, the other parts black; the setæ on the thorax arranged in rows, a slender median row, one on each side of this on the division between the dark stripes, and a wider lateral row of rather more conspicuous setæ reaching the base of the wings. Scutellar setæ as strong as those at the base of the wing. Abdomen dusky yellowish, the dorsum of the first segment, basal half of the second, the immediate bases of the remaining segments, the whole of the prominent hypopygium (fig. 103), under side of trochanters, and setæ of abdomen, black. Legs including the coxæ, yellow; tarsi appear dusky owing to the black setulæ. Tibial setæ less than half as

long as the diameter of tibia, several rows on each tibia, six to eight on the fore, eight to twelve on the intermediate, and twelve to fifteen setæ on hind tibia in each row. Tarsal claws with teeth. Fore metatarsus is about .8 as long as the tibia. Wings (fig. 86) hyaline, yellow tinged; veins dusky yellow; subcosta ends opposite or slightly beyond the base of the radial sector, R_{2+3} oblique, coalesced part of the media about half as long as the petiole, anal reaches the margin of the wing. Halteres yellow. Two specimens from Dewatto, Washington, collected by Prof. Aldrich. This species seems to be closely related to *pullata* Coq.

5. *Platyura lurida* Coquillett.

1895. *lurida* Coquillett. Canad. Ent. 199.

Female. Length 6 mm. Head and antennæ black, first two joints of the latter and the mouth parts somewhat yellowish. Thorax, pleura, scutellum, abdomen and legs, pale yellow, the tarsi toward the apex brownish yellow, the thorax marked with three reddish yellow vittæ. Wings hyaline, slightly tinged with yellowish toward the costa, otherwise unmarked; tip of subcostal vein nearly twice the length of the humeral crossvein beyond the base of the radial sector; subcostal crossvein nearly three times the length of the humeral beyond the latter; R_{2+3} oblique, ending its own length beyond the tip of R_1; anal vein reaches the wing margin. Washington.

6. *Platyura pictipennis* Williston.

1896. *pictipennis* Williston. Trans. Ent. Soc. London. 257.

Male and female. Length 3-3½ mm. Front and face yellowish or brownish, the palpi darker colored. Antennæ brownish, about as long as the thorax, moderately compressed. Thorax yellow; the dorsum, save a yellowish spot or stripe in the middle, and the yellow lateral margins, brown or black; disk and sides of the metanotum brown. Abdomen brown or blackish-brown, the posterior margin of each segment yellow. Legs, including the coxæ, yellow, the distal portion of the tibiæ, and the tarsi, brownish; tibiæ without spines; front tibiæ and metatarsi of nearly equal length; the hind metatarsi shorter than their tibiæ; all the tibiæ with a single spur. Wings nearly hyaline, with markings as follows: a large brown spot, reaching

from the costa to the cubitus, over the prefurca; another of about the same size in the outer part of the cell R_{4+5}; and smaller ones in all the cells on the posterior side of the wing; R_{2+3} runs into the costa a little beyond the tip of R_1. St. Vincent Isl., W. I.

7. *Platyura elegans* Coquillett.

1895. *elegans* Coquillett, Proc. Acad. Nat. Sc. Phila. 307.

Male and female. Length 3.5 mm. Head black, lower part of front and the face yellow; antennæ black, the two basal joints yellow; proboscis yellow, its apex and the palpi black. Dorsum of thorax opaque brownish black, the sides, pleura and scutellum, yellow; metanotum brown, this color extending upon the pleura to the middle coxæ. Abdomen shining brownish-black, the first segment, both ends of the second, apices of the third and fourth and the whole of the fifth, yellow; first five ventral segments also yellow. Halteres and legs yellow; tibiæ destitute of bristles. Wings grayish hyaline, marked with two irregular brown crossbands and with two brown spots; the first band begins at R_1 before its tip, is interrupted between the branches of the cubitus, and stops before reaching the hind margin of the wing, its posterior portion scarcely half as wide as the costal part; the second band starts from the tip of R_{2+3} and stops at Cu_1 a short distance before its tip, where the band is scarcely one-fifth as wide as at the costa; midway between these two bands is a large brown spot reaching from Cu_1 to the hind margin of the wing at the tip of the posterior branch; a brown cloud on R_{2+3}, this branch terminating at twice its length beyond the tip of R_1. Georgetown, Florida, May; North Carolina.

I have seen specimens from Ithaca and Yonkers, N. Y.; Wisconsin and North Carolina. In the northern specimens the middle of the mesonotum is yellow, leaving two distinct dark lateral stripes; agreeing in this respect with *pictipennis* which appears to be closely related if not identical. In the Carolina specimen the middle of the mesonotum is only slightly paler brown than the sides. The fore metatarsus is about one-fifth shorter than the tibia, and the subcostal vein ends about opposite the base of the radial sector.

8. *Platyura mimula* n. sp.

Male. Length 2 mm. Head fuscous, scape of antenna and mouth parts yellowish; flagellum of antennæ dusky yellow. Thorax dusky yellow, humeri and lateral margin of mesonotum somewhat paler, metanotum brownish. First four abdominal segments dusky yellow, posterior margin slightly paler; remaining segments as well as the hypopygium dark brown, subopaque. Hypopygium about as wide as the last visible abdominal segment, the superior forceps subtriangular. Legs yellow, tarsi slightly darker, spurs black; fore metatarsus half as long as its tibia. Wings hyaline, veins dusky yellow; the subcosta ends in the costa before the base of the radial sector; the subcostal crossvein indistinct, R_{2+3} oblique, coalesced part of the media about two-thirds as long as the petiole, anal vein apparently reaches the margin. Halteres yellowish. From Polk Co., Wisconsin.

Two females from Hampton, N. H., collected in June by Mr. S. A. Shaw are marked as follows: The head, thorax and abdomen dark brown, subshining; the palpi, scape of antennæ, pleura, sterum, venter and narrow posterior margin of the abdominal segments more yellowish; wings more cinerous; anal vein does not reach the margin; in other respects, venation and leg measurements as in the male.

9. *Platyura melasoma* Loew.

1869. *melasoma* Loew, Berl. Ent. Zeitschr. XIII. 135.

Female. Length 6 mm. Black. Anterior and lateral margins of the mesothorax and margin of the scutellum, yellowish; the scutellum itself fuscous black. Abdomen black and with black pile, the first segment more fuscous. Legs and coxæ pale, tibiæ dusky yellow, tarsi blackish. Wings subhyaline, tinged with dusky yellow, darker on the costal margin; subcostal vein ends in the costa opposite the base of the radial sector, the subcostal crossvein wanting; the rather long and oblique R_{2+3} ends in the costa not far distad from the tip of R_1. Length of wing 5 mm. Halteres yellow. Recorded from D. C.

To this description I may add that the preapical wing cloud is short but distinct; the coalesced part of the media is equal or

greater than the petiole. The legs in the type specimen at Cambridge are more or less broken.

10. *Platyura pullata* Coquillett.

1904. *pullata* Coquillett, Proc. Ent. Soc. Wash. VI, 171.

Female. Length 3½ mm. Black, the mouth parts, sides of mesonotum, the scutellum, metanotum, hind margins of the abdominal segments, the genitalia, venter, coxæ, femora, tibiæ, bases of tarsi, and the halteres, yellow; hairs and bristles chiefly black. Thorax thinly gray pruinose, the abdomen polished. Wings hyaline, apex of the subcosta opposite the base of the radial sector, the subcostal crossvein near one-fourth of distance from the humeral to the apex of the subcosta, R_{2+3} very oblique terminating about its own length beyond the apex of R_1, anal vein prolonged to the wing margin. Claremont, Calif.

11. *Platyura nigrita* n. sp.

Male. Length 4½ mm. Head black, palpi, mouth parts, antennæ including scape, fuscous, intermediate antennal joints longer than broad. Thorax subopaque, brownish black, the collar, humeral spots and narrow lateral margin of mesonotum yellowish; scutellum brownish, sparsely setose; the three narrow longitudinal rows of setulæ extending nearly to scutellum and a wider row on each lateral margin extending to base of wing. Abdomen brownish black, subshining; posterior margin of some segments on dorsum faintly on venter more distinctly yellowish. Hypopygium (fig. 92) small, black. Legs yellow, tarsi apparently more dusky due to setulæ; middle and hind tibiæ each with several rows of very short and small setæ, 6 to 10 in a row; fore claws with 2 teeth near base; fore metatarsus about 2-3 as long as its tibia. Wing hyaline, apex very slightly darker, veins yellow except the radius which is brown; subcosta ends before the base of the radial sector; R_{2+3} oblique, coalesced part of media about half as long as the petiole, anal vein reaches the margin of the wing. Halteres yellow. Taken at Friday Harbor, Washington, in June by Professor Aldrich.

12. *Platyura notabilis* Williston.

1894. *notabilis* Williston. Kansas Univ. Quart. II. 59.

Male. Length 8 mm. Antennæ black, not compressed, a half longer than the thorax; first two joints yellow. Face and lower part of the front reddish yellow; epistoma projecting, beak-like; palpi and proboscis yellowish; front, except the lowermost portion, black. Thorax yellow, the mesonotum somewhat reddish; a blackish spot on the proximal part of the hind coxæ and the adjacent portion of the pleura; a fringe of black hairs just above the root of the wings. Abdomen reddish yellow, with short, black hairs. Legs yellow, the tibiæ and tarsi infuscated or blackish; front tibiæ bare, the middle and hind pairs with short spinules. Wings yellowish, the tip infuscated; a feebly marked brownish band before the tip; the subcostal vein terminates at the origin of the radial sector; R_{2+3} joins the costa just beyond the insertion of R_1. Anal vein complete. Washington.

13. *Platyura ignobilis* Williston.

1896. *ignobilis* Williston. Trans. Ent. Soc. London. 257.

Male. Length 3 to 4 mm. Base of antennæ and the face yellow; front and occiput blackish. Thorax reddish-yellow, the dorsum with black hair arranged in distinct rows. Scutellum and metanotum brownish. Abdomen brownish-yellow, with black hair. Legs yellow, the tarsi infuscated; front metatarsi not more than three-fourths the length of the tibiæ. Wings uniformly subinfuscated; R_{2+3} is nearly rectangular, terminating in the costa; the subcostal vein is very short. St. Vincent Isl.

14. *Platyura fascipennis* Say.

1824. *fascipennis* Say. Long's Expedition. App. II. 360.

Female. Length 4½ mm. Head yellow; center of vertex black. Mesonotum yellow, unmarked or at most with only a faint indication of deeper yellow stripes. Abdomen fuscous, slender at the base, gradually broadening posteriorly; venter dusky, posterior and lateral margins inclined to dusky yellow. Legs and coxæ pale, tarsi infuscated; fore metatarsus about one and one-fifth times, the second fore tarsal joint is about

two-thirds times the tibia in length. Wing yellowish with a brown band near the tip; the coalesced part of the media and its petiole subequal in length; subcosta ends noticeably before the base of the radial sector; R_{2+3} nearly perpendicular to R_{4+5}; the subcostal crossvein is placed slightly proximad of the midpoint between humeral crossvein and apex of the subcosta; anal vein not produced to the margin. Halteres yellow. One specimen taken at Montreal in July.

Var. *sagax* n. var. Male. Length 5 mm. Differs from the female in having a paler abdomen, spot on wing less conspicuous and relatively longer legs. Antennæ and front except lateral margin, dark brown; occiput, face, palpi and scape of the antennæ yellow. Antennæ short, the intermediate joints no longer than wide, the hairs black. Mesonotum yellow with four narrow brown stripes, scutellum, pleura and sternum yellow, metanotum slightly infuscated; setæ of the mesonotum, pleura and sternum yellow; metanotum slightly infuscated; thoracic setæ short, black, and not arranged in longitudinal rows. Abdomen yellow, the base of the dorsum of the penultimate and the whole of the ultimate segment brown; hypopygium (fig. 102) mainly brown. Coxæ and legs yellow; tarsi apparently darker; claws each with a slender basal tooth which is over half as long as the claw; fore metatarsus is about one and one-fifth, the second fore tarsal joint about 0.9 as long as the tibia. Wings hyaline, yellow tinged, apex of R_{4+5} and costa with a faint cloud; subcosta ends noticeably proximad of the base of the radial sector; subcostal crossvein indistinct; coalesced part of the media about equal to the petiole; R_{2+3} perpendicular to R_{4+5}; anal vein does not appear to reach the margin. Halteres yellow. Capens, Maine, taken in July, by Mr. C. W. Johnson.

This variety differs slightly from *subterminalis* in the relative length of metatarsi, petiole of media, and in form of hypopygium.

15. *Platyura fasciventris* Williston.

1896. *fasciventris,* Williston, Trans. Ent. Soc. London. 258.

Female. Length 5 to 6 mm. Head and basal joints of the antennæ reddish-yellow, the distal joints of the antennæ black or brownish-black; the oval ocellar spot black. Front broad,

the orbits emarginate. Thorax reddish-yellow; the dorsum red, with four brown stripes, sometimes feebly marked or obsolete. Abdomen red, or reddish-yellow, with a black band of variable width at the posterior part of each segment; venter yellow. Coxæ and femora light yellow; tibiæ yellow, the tarsi brownish; tibiæ without spines; metatarsi about as long as their tibiæ; all the tibiæ with a single terminal spur. Wings uniformly brownish; R_{4+5} oblique, terminating in the costa. The antennæ are about as long as the dorsum of the thorax. St. Vincent Isl.

16. *Platyura moesta* n. sp.

Male. Length 4 mm. Head black; antennæ fuscous, scape and mouth parts yellow. Thorax dull yellow with five longitudinal lines of black setulæ, lateral lines widest, setulæ longest over base of wings and upon scutellum; metanotum slightly brownish. Basal half or two-thirds of each abdominal tergite black, whole of remaining tergites black, venter yellow except for the black apical margin of each segment; hypopygium (fig. 106) brown. Legs yellow, tibiæ and tarsi apparently darker; fore metatarsus about 5-8 as long as the tibia; each claw with three teeth. Wing hyaline, slightly cinereous; veins yellow, the heavier veins more dusky; subcosta ends proximad of base of the radial sector, the crossvein is proximad of the first third of distance from the humeral crossvein to apex of the subcosta; R_{2+3} oblique and ends about one-fourth of the distance from tip of R_1 to tip of R_{4+5}; coalesced part of the media is about 2-3 as long as the petiole, anal vein produced to the wing margin. Halteres yellow. Taken August 2 at Longmire's Springs, Mt. Rainier, Washington, by Professor Aldrich.

17. *Platyura mendosa* Loew.

1869. *mendosa* Loew, Berl. Ent. Zeitschr. XIII. 135.

Male. Length 3.5 to 4 mm. Deep yellow, antennæ except the scape, and abdomen dusky; tarsi apparently fuscous; fore metatarsus about one-sixth shorter than the tibia. Wing yellowish, cinereous tinged, veins yellowish; apex of the R_{4+5} and the costa with an indistinct cinereous cloud; subcosta ends in the costa about two-thirds of the length of the basal cell. Subcostal crossvein is proximad of the middle of the subcosta;

R_{2+3} oblique; coalesced part of the media about a third as long as the petiole; anal vein produced to the margin; the distance from the humeral crossvein to the base of the radial sector is about one-fourth of the distance to the tip of the wing. Halteres yellow. The hypopygium is robust (fig. 99) the forceps lobe-like. Ithaca, N. Y.; Capens, Maine, July (C. W. Johnson); Knoxville, Tenn. My specimens are like the type in the museum at Cambridge, Mass., which is recorded from the District of Columbia.

18. *Platyura mendica* Loew.

1869. *mendica* Loew. Berl. Ent. Zeitschr. XIII. 135.

Female. Length 3 mm. Yellowish, legs paler, tarsi more dusky. Antennæ rather short, fuscous, the basal joints yellowish. The base of each abdominal segment subfuscous. Wings uniformly yellowish with a tinge of cinereous, veins fuscous; subcostal vein ends in the costa a little proximad of the base of the radial sector; R_{2+3} rather long and oblique in position; length of wing 3 mm. Halteres yellow. Recorded from New York.

A female specimen from Hampton, N. H., collected by Mr. S. A. Shaw is 4 mm. long; thorax with indications of three pale brown confluent stripes; fore metatarsus one-fifth shorter than the tibia; subcostal vein ends nearly opposite base of the radial sector; the subcostal crossvein is situated about the length of the humeral crossvein beyond the latter; the tip of R_{4+5} and costa very faintly tinged with brown; coalesced part of media about half as long as its petiole; anal vein prolonged to the margin. Excepting for the brown tinge near tip of wing these characters are also possessed by the type in the museum at Cambridge.

A female specimen from Blue Hills, Mass., collected by Mr. C. W. Johnson, in July is similar but thoracic stripes are more distinct, the brown on the abdomen more extended, and without a suggestion of brown near tip of wing.

Some defective specimens from Wisconsin, Oregon and Ithaca, N. Y., seem also to belong here.

19. *Platyura subterminalis* Say.

1829. *subterminalis,* Say. Journ. Ac. Nat. Sc. Phila. IV. 152.

Male and female. Length 3½ to 4 mm. Body entirely pale honey yellow; antennæ excepting the two basal joints, fuscous; ocelli with a small black areola; thorax immaculate; tergum a little more dusky than the thorax. Tibiæ and tarsi dusky. Wings with a slight yellowish tinge, a blackish subterminal band, occupying on the costal margin all the space between R_{2+3} and R_{4+5} and extending to the posterior margin; R_{2+3} is perpendicular to the costa.

In two male specimens from Ithaca, N. Y., the hypopygium is as shown in figure 104; the fore metatarsus is about 1.4 times, the second fore tarsal joint 7-8 times the fore tibia in length; the subcosta ends proximad of the base of the radial sector; the subcostal crossvein is situated proximad of the mid distance of humeral crossvein and tip of the subcosta; R_{2+3} is perpendicular to R_{4+5}; the petiole of the media is less than half as long as the coalesced part; the anal vein does not reach the margin.

Var *nexilis* n. var. Differs from the typical form in having R_{2+3} oblique to R_{4+5}; the coalesced part of the media and the petiole subequal and a slight difference in the hypopygium (fig. 107). One specimen from Polk Co., Wisconsin.

20. *Platyura diluta* Loew.

1869. *diluta,* Loew. Berl. Ent. Zeitschr. XIII. 134.

Male and female. Length 5 mm. Luteous. Antennæ short, fuscous or subfuscous. The immediate bases of the abdominal tergites sometimes fuscous; the last visible segment and the hypopygium of the male fuscous. Legs pale, tarsi dusky. Wings yellowish, with a short, dilute, subapical fascia; R_{2+3} short, oblique. Halteres yellow. Recorded from D. C.

I have seen specimens from New York, North Carolina, Wisconsin and Vermont. The hypopygium is shown in figure 98. The fore metatarsus is about 1-6 longer, the second fore tarsal joint about 1-6 shorter than the tibia. The subcosta ends in the costa proximad of the base of the radial sector; the subcostal crossvein is slightly proximad of the midpoint between the humeral crossvein and the tip of the subcosta; R_{2+3} oblique;

the coalesced part of the media is about 2-3 as long as the petiole; the anal vein does not reach the margin. These characters are also possessed by the type in the Cambridge museum.

21. *Platyura moerens* n. sp.

Male and female. Length 5 mm. Head, palpi, and scape yellow; the middle of the front surrounding the ocelli and the flagella brown. Thorax wholly yellow, with only faint indications of darker lines; setæ black, not arranged in longitudinal lines. Abdomen yellow, the immediate bases of the segments more or less brownish, especially in the female; hypopygium as figured (fig. 96). Legs yellow, tarsi appearing darker due to black setulæ; fore metatarsus 1.14, the second tarsal joint 0.94 times the tibia in length. Wings (fig. 84) yellowish hyaline; the subcosta ends in the costa before the base of the radial sector; the subcostal crossvein is about in the middle of the subcosta; R_{2+3} is oblique; coalesced part of the media about one-third longer than the petiole; anal vein not produced to the margin; a pale brown diffuse preapical fascia extends from between R_{2+3} and apex of the costa to beyond the media, quite faint posteriorly. Halteres yellow. Friday Harbor Washington, July, from Professor Aldrich.

22. *Platyura genualis* n. sp.

Male and female. Length 5½ mm. Head and mouth parts yellow; the flagellum and a spot covering ocelli and extending to the occiput, brown. Thorax yellow with only faint indications of ferruginous stripes; metanotum with brownish spot; setæ of the mesonotum black, very few in number except at the base of the wing and on posterior margin where they are longer and more conspicuous. Abdomen, including venter, yellow; basal third or fourth of segment with a brown fascia which may be more or less emarginate; setæ few, black; hypopygium stout, (fig. 100) yellow, setæ black. Legs yellow, tarsi apparently fuscous; fore metatarsus subequal to, second fore tarsal joint about two-thirds as long as its tibia; empodium small, pectinate, claws each with two stout teeth. Wing hyaline, cloud at apex of costa extends indistinctly to M_2; subcosta ends before the base of the radial sector; the subcostal crossvein is

placed near the middle of the subcosta; R$_{4+5}$ is oblique and ends in the costa; coalesced part of the media is one-third shorter than the petiole; anal vein is not produced to the margin. Halteres yellow. Pine Lake, Wisconsin (W. M. Wheeler); Black Mts., N. C. (Beutenmueller); Knoxville, Tenn.

23. *Platyura scapularis* n. sp.

Male. Length 5 to 6 mm. Head piceous, front subshining black; the posterior eye margin, scape of antennæ and clypeus rufo-piceous; flagellum fuscous, palpi and proboscis yellowish. Mesonotum black subopaque, collar, scutellum, humeri, and lateral margins to the base of the wings, articulations at base of wing, junction of scutellum and metanotum, yellowish; the metanotum including the prominent lateral lobes, pleura, and sternum rufo-piceous. Setæ of mesonotum, black, short, and apparently not arranged in rows, but uniformly distributed, most conspicuous at the base of the wing; those on the scutellum numerous but short. Abdomen subopaque black, some of the ventral segments more or less yellowish, particularly on the posterior margins; hypopygium (fig. 105) black. Legs and coxæ yellow, the middle and hind coxæ sometimes, and tarsi and spurs, fuscous; the black setulæ of coxæ conspicuous at tip; claws toothed; fore metatarsus nine-tenths, the second fore tarsal joint two-thirds as long as the tibia. Wing somewhat smoky, apex from before the tip of R$_{4+5}$, brown; subcosta ends in the costa before the base of the radial sector; the subcostal crossvein is situated proximad of the middle of the subcosta; R$_{2+3}$ slightly oblique, coalesced part of the media longer than the petiole in length; anal vein not reaching margin. Halteres yellow. Kendrick, Idaho, and Stanford University, Calif. (Prof. Aldrich).

Female, and immature male. The humeri, lateral margins of mesonotum, base of scutellum, and posterior margins of the abdominal segments yellow. Females from Friday Harbor and Moscow, Idaho. (Prof. Aldrich).

24. *Platyura elegantula* Williston.

1900. *elegantula* Williston. Biol. Centr. Amer. I. 218.

Female. Length 8 mm. Head yellow, the upper portion, to a line just in front of the ocelli, shining black. Palpi and tip of the proboscis brownish. Antennæ brown, the first two joints yellow; in length equal to that of the mesonotum. Mesonotum yellow, with three coalescent black stripes, of which the lateral ones are abbreviated in front; just above the root of the wings the more abundant black hair gives the appearance of a slender black spot. Pleura yellow, the mesosternum and the lower part of the metasternum brown. Metanotum brown, the sides silvery in some lights. Scutellum blackish. Abdomen brownish; the anterior part of the first, third and fourth segments reddish yellow; venter almost wholly of the latter color. Coxæ and femora yellow; tibiæ and tarsi brownish or blackish. Wings strongly tinged with brownish-yellow, the distal portion clouded with brownish; R_{2+3} a little shorter than the section of the costa beyond the tip of R_1; subcostal vein strong, terminating nearly opposite the origin of the radial sector; prefurca of the media a little more than half the length of the first section of the radial sector. Mexico, Omilteme in Guerrero 8000 feet.

A specimen from Arizona, perhaps immature, has vertex and abdomen yellowish brown; thoracic stripes brown; palpi and scutellum yellowish; fore metatarsus is about .95 as long as the tibia; subcosta ends slightly before the base of the radial sector; the subcostal crossvein is midway between the humeral crossvein and the tip of the subcosta; R_{2+3} is quite oblique; the coalesced part of the media is about a third longer than the petiole.

25. *Platyura tæniata* Winnertz.

1863. *tæniata* Winnertz Verh. zool.-bot. Ges. Wien. XIII. 701.

Male and female. Length 8 to 9 mm. Reddish; antennæ, front and vertex fuscous or subfuscous; thorax with black stripes; abdomen of the male fuscous, with first segment reddish; of the female sordidly yellowish brown, the segments with fuscous posterior margins. Legs reddish, tarsi fuscous. Wings cinereous, with a fuscous subapical fascia. Fore metatarsus about a twelfth shorter than the tibia. Subcostal

vein ends in the costa opposite the base of the radial sector; subcostal crossvein proximad of the middle of the subcosta; R_{2+3} oblique; anal vein strong but does not quite reach the wing margin. This European species has been recorded from New Jersey.

26. *Platyura divaricata* Loew.

1869. *divaricata,* Loew. Berl. Ent. Zeitschr. XIII. 134.

Male. Length 3.2 mm. Luteous. Flagellum of the antenna rather short, fuscous. Abdomen wholly yellow except for the small terminal segment which is fuscous, hypopygium blackish. Wings with yellowish tinge, apical third of wing cinerous fuscous, extreme tip cinereous; subcosta ends in the costa proximad of the base of the radial sector; subcostal crossvein slightly proximad of middle of subcosta; R_{2+3} nearly perpendicular to R_{4+5}; cell M_1 wider than in *P. subterminalis;* coalesced part of the media equal or slightly greater than the petiole; anal vein does not quite reach margin of the wing. Length of wing 3.2 mm. Fore metatarsus about .3 longer than its tibia. Recorded from Georgia. Described from the type specimen in the Museum at Cambridge, Mass.

5. Subfamily *Macrocerinæ.*

Macrocerinæ, Winnertz. Verh. zool-bot. Ges. Wien. XIII. 675. 1863.

This subfamily differs from the *Ceroplatinæ* primarily in having extremely long antennæ, often much longer than the body. There is but one living genus.

Genus *Macrocera* Meigen.

? *Euphrosyne* Meigen, Nouv. classif. des mouches. 16. 1800, Doubtful type.

Macrocera, Meigen, Illiger's Mag. II. 261. 1803; Klass. I. 1804.

Head broad, oval; eyes oval, slightly emarginate; the anterior median ocellus smaller than the laterals; palpi four jointed; antennæ 2+14 jointed, often much longer than the body. Thorax highly arched; abdomen depressed, with seven visible segments. Legs long and slender, the fore pair much shorter; tibial setæ wanting or very minute; spurs small. Wing (fig. 90)

broad, usually longer than abdomen; subcosta ends in the costa; subcostal crossvein present, basal in position; costa produced beyond the tip of $R_{1}+_{2}$; $R_{2}+_{3}$ oblique, and often sinuous, ending in the costa; the basal section of the media usually present, though delicate and fold-like, dividing the basal cell, coalescing with the radial sector before the crossvein, differing in this respect from *Apemon* and *Hesperodes* where the coalescence takes place distad of the crossvein; anal vein more or less sinuous, and reaching the wing margin; hypopygium (figs. 93, 94) consists of simple forceps resembling those of *Apemon*.

Table of species.

a. Apex of wing hyaline.
  b. A distinct spot covering petiole of the media.
    c. Length 4 to 5 mm; thoracic stripes and bases of abdominal segments brown.
      d. With a preapical and a central spot on wing. 1. *diluta*.
      dd. No preapical spot. 2. Specimen from Wyo.
    cc. Length 3 mm; abdominal fascia subobsolete; apex of R_{1} thickened. 3. *inconcinna*.
  bb. No spot covering petiole of media, or at least very indistinct.
    c. Apex of R_{1} much thickened, the costa thickened from apex of R_{1} to that of $R_{2}+_{3}$; tip of $R_{2}+_{3}$ four times as remote from tip of $R_{4}+_{5}$ as from R_{1}. 4. A defective specimen from Pine L. Wis.
    cc. Apex of R_{1} not distinctly thickened. 5. *immaculata*.

aa. Apex of wing dusky.
  b. With a preapical as well as an apical band on the wing.
    c. Abdomen luteous, apex blackish.
      d. Wing with four irregular fasciæ; the first extending from apex of the subcosta to the anal angle. 6. *nebulosa*.
      dd. No fascia extending back from apex of subcosta; R_{1} not thickened. 7. *hirsuta*.

cc. Apex of each abdominal segment blackish; distance from tip of R_{2+3} to R_{4+5} over twice as great as from R_1 to R_{2+3}; wing with two fascia connected with each other along the veins and two smaller spots.

d. Thorax not striped. 8. *formosa.*

dd. Thorax with stripes.

8a. *formosa,* var. *indigena* n. var.

bb. With but a single cloud on apex of wing, no preapical fascia.

c. Apex of R_1 thickened.

d. Antennæ of male four times, of female at least twice the length of the body.

e. Thoracic stripes wanting or but feebly indicated. 9. *clara.*

ee. Thoracic stripes brown. 10. *concinna.*

dd. Antennæ of female less than one and one-half times the length of the body. 11. Sp.

cc. Apex of R_1 not thickened; distance from R_1 to 2_{2+3} about three-fourths as great as from R_{2+3} to R_{4+5}. 12. *geminata* n. sp.

1. *Macrocera diluta* Adams.

1903. *diluta,* Adams. Kas. Univ. Science Bulletin II. 22.

Male: Yellow, shining; antennæ, except base, two stripes on occiput, three fascia on mesonotum, the central one joining two narrow ones coming from base of wings, three spots on pleura, lower half of metanotum, base of abdominal segments from the third, with hypopygium wholly, small spot on base of middle and posterior coxæ, tips of femora and tibiæ, dark brown; wings hyaline, fascia near central part dark brown, a small fuscous spot on anterior margin about midway between tip of R_{2+3} and apex of wing, not reaching the media.

Female: Agrees with the male, except that all of the abdominal segments, without the first, have the base dark brown; the subapical spot of wing is larger, crossing M_1. Length 5 mm.; antennæ, 7 mm. Arizona, August.

2. *Macrocera sp.*

Female. Length 4 mm. Antennæ partly missing; the first flagellar joint about as long as the second fore tarsal joint. Color reddish yellow, head infuscated; three wide black thoracic stripes; basal half of each abdominal segments blackish, last segment black; venter mainly yellowish; legs yellow, tarsi infuscated; fore metatarsus about .6, second tarsal joint about .3 as long as the tibia. Wing hyaline; medium brown band extends from apex of R_1 diagonally proximad to the posterior branch of the cubitus filling the space traversed by the petiole of the media; apex of the wing at the tip of R_{4+5} slightly yellowish; apex of R_1 slightly thickened; R_{2+3} ends nearly midway between apices of R_1 and R_{4+5}. One defective and apparently discolored specimen from Little Wind River, Wyoming, taken in September by W. M. Wheeler.

3. *Macrocera inconcinna* Loew.

1869. *inconcinna* Loew. Berl. Ent. Zeitschr. XIII. 133.

Female. Length 3mm. Yellowish, thoracic stripes and abdominal fasciæ indistinctly pale brownish. Antennæ over one and one-half times as long as the body; the flagellum black. Legs pale yellowish, tarsi deep fuscous. Wing cinereous, toward the tip and toward the posterior margin with longer pile and a little more deeply cinereous; R_1 thickened at the apex; R_{2+3} short, oblique; on the disk with a large subfuscous spot, extending from a fuscous longitudinal line which lies in the cell R_1 to Cu_2; also a faint cuneate spot in the basal cell R; length of the wing 4 mm. Halteres yellow. Recorded from the District of Columbia. In the type specimen the apex of R_{2+3} is close to tip of R_1 and widely remote from R_{4+5}, as in *M. clara.*

4. *Macrocera sp.*

Two defective specimens from Pine Lake, Wisconsin, collected by Prof. W. M. Wheeler, resemble *immaculata* and *inconcinna* in some respects but differ from each. The petiole of the media is surrounded by a very faint cloud; the subcosta ends about opposite the coalesced part of the media; R_1 is thickened at the tip and ends less than the length of the petiole of

the media before the tip of R_{2+3} which is short but quite oblique. The antennæ are yellow but are infuscated beyond the third joint. Most of the legs, greater part of the antennæ and abdomen are wanting in both specimens.

5. *Macrocera immaculata* Johnson.

1902. *immaculata,* Johnson. Canad. Ent. XXXIV. 240.

Male and female. Length 5 mm. Head yellow, vertex brownish; antennæ dark brown, the 2 basal joints yellow. Thorax dark yellow, with the anterior margin and humeri light yellow. Abdomen dark brown, shining, with a wide yellowish posterior margin on each segment. Legs yellow, slightly brownish at the tips of the femora, tibiæ and tarsi; legs and abdomen in the male with fine black hairs, which are less conspicuous in the female. Wings yellowish hyaline, with a slight brownish stigma and very fine hairs. The antennæ and posterior legs each about double the length of the body. Pa. and N. Y. (June).

6. *Macrocera nebulosa* Coquillett.

1901. *nebulosa,* Coquillett, Proc. U. S. Nat. Museum XXIII. 594.

Male and female. Length 4 to 5 mm. Yellow, the antennæ except the base, three large spots on the pleura, knobs of halteres bases of abdominal segments two to five and whole of abdomen beyond the fifth segment in the male, the base of each segment except the first in the female, also the tarsi, dark brown; body polished; wings bare, hyaline, marked with four irregular brown fasciæ; the first begins at apex of subcostal vein and extends to the anal angle; the second extends from apex of R_1 to apex of the anal, and is almost, or quite, interrupted in the medial cell; the third extends from R_{2+3} to apex of Cu_1, while the last one borders apex of wing and is connected with the preceding one along R_{4+5} and both branches of the media. Recorded from New Hampshire and New Jersey.

7. *Macrocera hirsuta* Loew.

1869. *hirsuta,* Loew, Berl. Ent. Zeitschr. XIII. 132.

Male. Length 5.2 mm. Yellowish, with long black pile. Vertex subfuscous; antennæ scarcely one and one-half times as

long as the body, blackish apically. Stripes on mesonotum and spots on the pleura subfuscous; abdomen blackish apically; hypopygium blackish. Coxæ yellow, posterior pairs fuscous at the apex, pile black; legs pale, tarsi subfuscous. Wings yellowish with light cinereous tinge, apically and posteriorly with rather long pile; a rather large central spot, fuscous; a complete subapical fascia and apex of wing, fuscous-cinereous; apex of R_1 not thickened; R_{2+3} very long and bent down, length of wing 5 mm. Halteres yellow. Recorded from the District of Columbia.

In the type specimen the distance from R_1 to R_{2+3} is about 1-3 or 1-4 as great as from R_{2+3} to R_{4+5}, and the bands at apex of wing are not connected with each other by clouds along the veins.

8. *Macrocera formosa* Loew.

1866. *formosa* Loew, Berl. Ent. Zeitschr. X. 6.

Male and female. Length 4 mm. Pale yellow. Antennæ yellow, darkened apically. Thoracic stripes wholly lacking or but faintly indicated. Posterior margin of each abdominal segment black, the last three in the male sometimes wholly black, forceps yellow. Legs pale, tips of the middle and hind femora black, of hind tibiæ subfuscous, tarsi subfuscous, darker towards the tip. Wing hyaline, apically and posteriorly with longer pile; a minute blackish spot near the base, a large spot on the middle extending from the costa to the cubitus; apex with two fasciæ, the first subapical, arcuate, the second apical; these bands coalescing on the costa and along the course of the veins. Recorded from New York.

Var. indigena, n. var. Differs from Loew's type specimen in having three distinct thoracic stripes which are usually brown, though in one specimen is almost black. The hypopygium is dusky yellow in the paler specimens, but is usually dark brown.

Male. Head and mouth parts yellow, vertex brown, antennæ yellow, infuscated toward the tip, about one and two-thirds times the length of the insect; mystax black. Thorax yellow with three dark brown stripes on mesonotum; sternum, metanotum and a spot on pleura near base of wing brown; setæ black; scutellum pale yellow with transverse row of small black setæ.

The first abdominal segment, the apices of the second, third, fourth, fifth, and the whole of the remaining segments brown, both dorsally and ventrally; hypopygium (fig. 93) usually dusky, setæ black, forceps with the two terminal teeth closely approximated. Coxæ and legs yellow, tips of middle and hind coxæ and tarsi infuscated; fore metatarsus .8 as long as its tibia, the second fore tarsal joint $\frac{3}{5}$ as long; pulvilli bushy, the hairs clavate, claws simple. Wings hyaline, hairy, especially towards the apex, veins brownish yellow; a brown cloud covers the petiole of the media, extending anteriorly reaching the subcosta and posteriorly to Cu_1, more or less interrupted in the second medial cell; the basal section of the radial sector with a brownish cloud; a narrow preapical fascia extends from the tip of R_{2+3} to beyond Cu_1, more conspicuous where intersected by a vein, and a broad apical band, separated from preapical fascia by a hyaline space as wide as this fascia; the subcosta ends about opposite the coalesced part of the media; R_1 is strong but not thickened at the apex; R_{2+3} is very oblique and somewhat longer than the petiole of the media, costa produced beyond the tip of R_{4+5} as far as the length of the M-Cu crossvein; anal vein strong, produced to the margin. Halteres yellow.

Female. Like the male, but the antennæ are only about one-sixth longer than the body and the brown fasciæ of the abdomen are more extended. Several specimens from Ithaca, New York.

9. *Macrocera clara* Loew.

1869. *clara* Loew, Berl. Ent. Zeitschr. XIII. 133.

Male and female. Length 3½ to 4 mm. Slender, pale yellowish, pile of the body pale. Antennæ slender, in the male nearly four times, in the female nearly three times as long as the body, scape yellowish, flagellum fuscous. Thorax unmarked; abdomen with long pale pile; each segment fuscous at the base. Coxæ and legs pale yellow, tarsi subfuscous toward the tip. Wings hyaline, apically and posteriorly with long pile; apex of R_1 thickened and infuscated, joined with the radial sector by a fuscous spot; a central fuscous spot interrupted anteriorly at the radial sector, extends posteriorly subobsoletely along Cu_1 to the margin; apex of wing widely fuscous; R_{2+3} short, pale,

oblique. Halteres yellow. Recorded from the District of Columbia.

To the above description may be added that between R_1 and the radial sector there is a thickening of the wing membrane simulating a longitudinal vein (fig. 90); fore metatarsus over two-thirds, the second foretarsal joint one-third as long as the tibia; front tibiæ suddenly dilated at their tip; thoracic stripes sometimes feebly indicated; hypopygium similar to that of *geminata*. The female specimens which I have seen, some of them coming from the same locality as the males, have black setulæ on the abdomen and rather wide black fasciæ; and the antennæ are twice not thrice as long as the body. Penn. and Tenn. (Aldrich), Wis. (Wheeler) and New York.

10. *Macrocera concinna* Williston.

1896. *concinna* Williston, Trans. Ent. Soc. London. 255.

Differs from *clara* only in having the three stripes on the thorax, a vertical stripe on the pleura, scutellum and metanotum, brown. It is more probably the same as *clara* and not *inconcinna* as Professor Williston has suggested. Recorded from St. Vincent Isl. W. I.

11. *Macrocera sp.*

A female specimen from Friday Harbor, Washington, taken in July by Professor Aldrich differs from *clara* in having shorter antennæ, but little longer than the insect; fore metatarsus a little over half as long as the tibia; and feebly indicated thoracic stripes. Venation and markings like *clara*.

12. *Macrocera geminata* n. sp.

Male. Length 4 mm. Head, face and mouth parts yellow; covering the ocelli a large brownish triangle the vertex of which extends onto the occiput; setæ of labrum and vertex black; antennæ about six mm. long, fuscous, the scape and the first flagellar joint except the base and the apex of each of the second, third and fourth joints more yellowish. Thorax shining yellow with shining brown markings as follows: the anterior margin of mesonotum with a large triangle, two broad stripes widening posteriorly and nearly meeting in front of the scutellum, a longitudinal dash behind the humeral callus

and extending nearly to the base of the wing, a large oval spot just below this, the ventral margin of the pleura just above the middle coxæ and the metanotum; the two longitudinal rows of fine setæ on the mesonotum mesad of the longitudinal stripes, two rows of larger setæ extending to the base of the wing, several pairs on the posterior margin, and a few less prominent ones on the scutellum, black. Abdomen yellow, the first segment pale brown, both dorsal and ventral sclerites of the other segments each with dark brown basal fascia about half the width of the segments anteriorly but wider on the posterior segments, the dorsal sclerites also with pale brown apical fasciæ; hypopygium brown (fig. 94) the two apical teeth far apart; setæ black. Coxæ and legs yellow, extreme apex of each femur and tibia, and the tarsi wholly infuscate; fore metatarsus two thirds, second foretarsal joint one-third as long as the tibia; tibial spurs about as long as the fourth tarsal joint; empodium distinct, bushy, claws simple. Wings hyaline with a brown, more or less broken zig-zag fascia which arises proximad of the apex of R_1, extends over the petiole of the media, produced slightly into its fork, narrows behind Cu_1 and reaches Cu_2 where it again slightly widens; a spot at the base of the media which may extend to the cubitus, another at the base of the cubitus, and the entire apex of the wing from the apical half of cell R_{2+3} to beyond Cu_1 with a very faint brown cloud, more conspicuous along the course of the veins; R_{2+3} very oblique and about as long as the petiole of the media; the distance from the tip of R_1 to R_{2+3} is about three-fourths as great as from R_{2+3} to R_{4+5}. Halteres yellow.

Female. Like the male but the antennæ are a trifle shorter, the yellow of the dorsal sclerites of the abdomen is less extended and the apex of the wing is a little darker. All from Ithaca, New York; June.

LEG MEASUREMENTS.

The table which follows gives the relative lengths of the joints of the legs, the fore tibia being taken as 100. As the measurements were for the most part made upon pinned specimens the values given may not be absolutely exact, due in part to the difficulty experienced in getting the object to be measured in a true horizontal plane. A variation of as much as four or five percent. may be expected in different individuals of the same species, and the proportions in the male differ somewhat from those of the female.

	Number of joint.	Palæoplatyura alfrichii, male.	Palæoplatyura johnsoni, male.	Cryptolabis terminalis, male.	Geroplatus militaris, male.	Cerotelion bellulus, male.	Apemon pretoralis, male.	Apemon nigriventris, male.	Apemon nigriventris, female	Platyura scapularis, male.	Platyura scapularis, female.	Platyura jascipennis var. suave, male.	Platyura fasciipennis female	Platyura inops male.	Platyura solitaria male.	Platyura minuta, male.	Platyura nigrita, male.	Platyura mocsta male.	Platyura mendosa male.	Platyura inenitica female.	Platyura alluta, male.	Platyura mocrens, male.	Platyura nemalis, male.	Platyura elegantula, female.	Macrocera formosa var. indigena, male.	Macrocera clara, male.	Macrocera clara, female.	Macrocera remanita, male.
Fore leg.	F.	75	85	90	85	90	82	93	96	85	90	79	-	71	91	100	84	87	85	-	70	74	95	80	75	85	88	84
	T.	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	1.	70	104	142	118	116	96	134	70	80	86	125	122	151	79	116	108	96	100	82	116	71	100	97	64	56	67	67
	2.	-	40	41	58	57	42	35	35	72	52	66	68	74	56	42	39	34	43	54	52	54	64	56	41	34	34	35
	3.	-	31	24	24	24	35	22	26	62	67	58	50	49	44	41	39	43	40	44	36	50	50	40	28	14	14	26
	4.	-	22	22	15	22	17	19	17	34	35	38	20	30	25	29	19	25	30	24	25	33	26	-	21	13	12	16
	5.	-	-	-	-	-	-	16	14	-	30	22	16	22	18	-	-	-	-	-	24	23	-	-	14	11	10	-	14
Middle leg.	F.	114	93	-	122	-	96	108	-	100	112	103	90	-	91	105	111	104	108	-	-	94	110	-	110	-	-	-	124
	T.	114	117	109	169	-	134	142	-	164	170	145	-	-	131	124	142	124	142	-	130	144	130	-	150	-	-	-	154
	1.	74	111	142	149	-	91	90	-	136	128	147	146	140	82	82	85	75	95	-	130	136	136	-	104	-	-	-	100
	2.	-	52	-	60	-	47	44	-	78	65	57	-	-	42	48	48	47	58	-	55	59	59	-	44	-	-	-	47
	3.	-	35	-	38	-	37	35	-	50	43	36	-	-	35	36	39	31	35	-	35	35	36	-	-	-	-	-	28
	4.	-	26	-	24	-	17	21	-	34	28	26	-	-	25	31	28	28	26	-	25	24	25	-	-	-	-	-	19
	5.	-	22	-	22	-	16	14	-	26	25	25	-	-	18	24	19	22	22	-	24	15	24	-	-	-	-	-	14
Hind leg.	F.	118	104	109	129	-	118	128	-	114	122	98	110	-	120	110	114	106	105	-	102	97	110	-	103	158	-	-	140
	T.	165	174	150	189	-	204	190	-	182	185	164	162	-	171	166	158	158	178	-	166	156	160	-	160	197	-	-	188
	1.	91	111	138	145	-	104	95	-	144	156	159	147	-	134	130	93	87	102	-	139	138	126	-	152	145	-	-	119
	2.	-	48	45	55	-	45	51	-	66	57	49	58	-	40	44	48	47	52	-	39	47	53	-	-	40	-	-	49
	3.	-	33	32	35	-	35	39	-	45	42	35	35	-	37	34	37	37	32	-	30	27	34	-	-	15	-	-	30
	4.	-	22	22	27	-	21	22	-	38	22	26	25	-	22	26	26	26	24	-	24	23	29	-	-	-	-	-	19
	5.	-	18	15	24	-	11	16	-	32	20	24	21	-	18	19	19	22	22	-	22	18	24	-	-	-	-	-	16

Explanation of Plates.

Plate. (Figs. 46 to 69 reduced from Plate 1 in Johannsen's Mycetophilidæ, Genera Insectorum).

Fig. 46. Head of Asindulum montanum.
" 47. Palpus of Ceroplatus.
" 48. Antenna of Ceroplatus.
" 49. Proboscis of Asidulum coxale.
" 50. Palpus of Exechia.
" 51. Antenna of Mycetophila.
" 52. Antenna of Cordyla.
" 53. Head of Gnoriste.
" 54. Palpus of Cordyla.
" 55. Ventral aspect of mouth parts of Mycetophila punctata.
" 56. Mycetophila punctata, female.
" 57. Tarsal claw of Mycetophila.
" 58. Tarsal claw of Ceroplatus.
" 59. Antenna of Diomonus.
" 60. Tibia and tarsus of Heteropterna (after Skuse).
" 61. Head of Hadroneura (after Lundström).
" 62. Hind tibia of Exechia.
" 63. Dorsal aspect of head of Mycomya (Sciophila Winnertz).
" 64. Proboscis and palpi of Arctoneura (=Cyrtoneura, after Marshall).
" 65. Dorsal aspect of head of Diomonus.
" 66. Antenna of Platyroptilon (after Westwood).
" 67. Dorsal aspect of head of Exechia.
" 68. Head of Lygistorrhina (after Skuse).
" 69. Frontal aspect of Leia (=Neoglaphyroptera Osten-Sacken).
" 70. Diagram of Palaeoplatyura wing.
" 71. " " Ditomyia wing.
" 72. " " Sciophilinæ wing.
" 73. " " Mycetophilinæ wing.

Explanation of Abbreviations.—C = Costa; Sc_1 and Sc_2 = anterior and posterior branches of the subcosta; R_1, R_{2+3}, and R_{4+5} = branches of the radius; Rs = radical sector = $R_{2+3}+R_{4+5}$; M_{1+2} and M_3 = branches of the media; Cu_1 and

Cu_2 = branches of the cubitus; A = anal veins; R-M = radio-medial crossvein; M-Cu = medio-cubital crossvein.

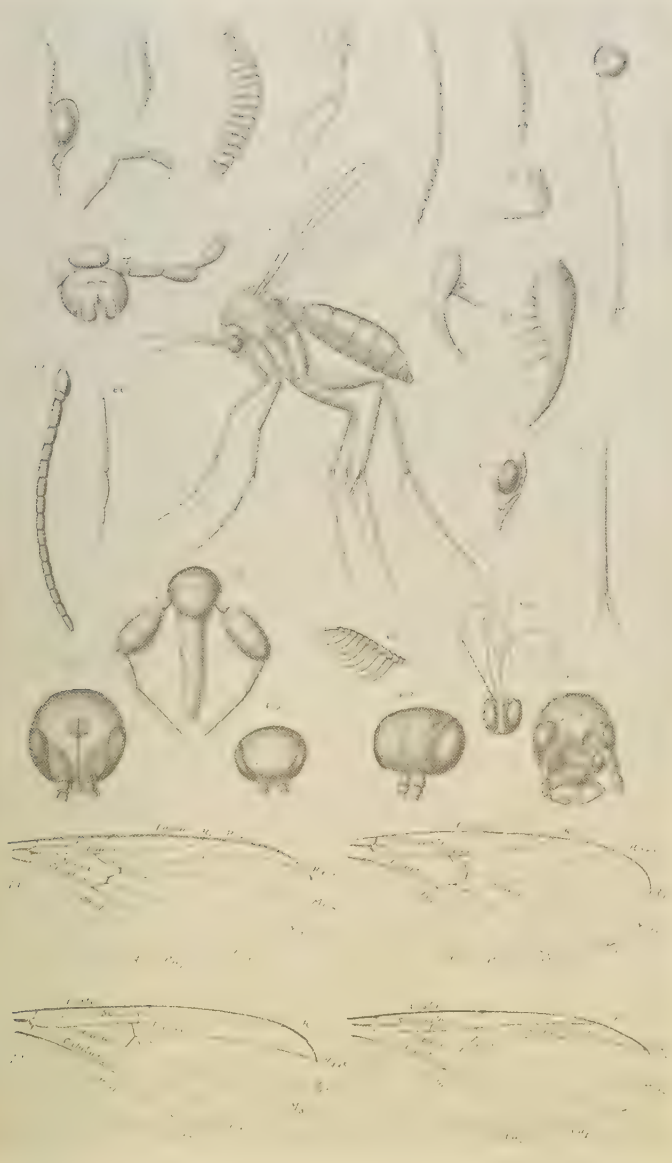
Plate.

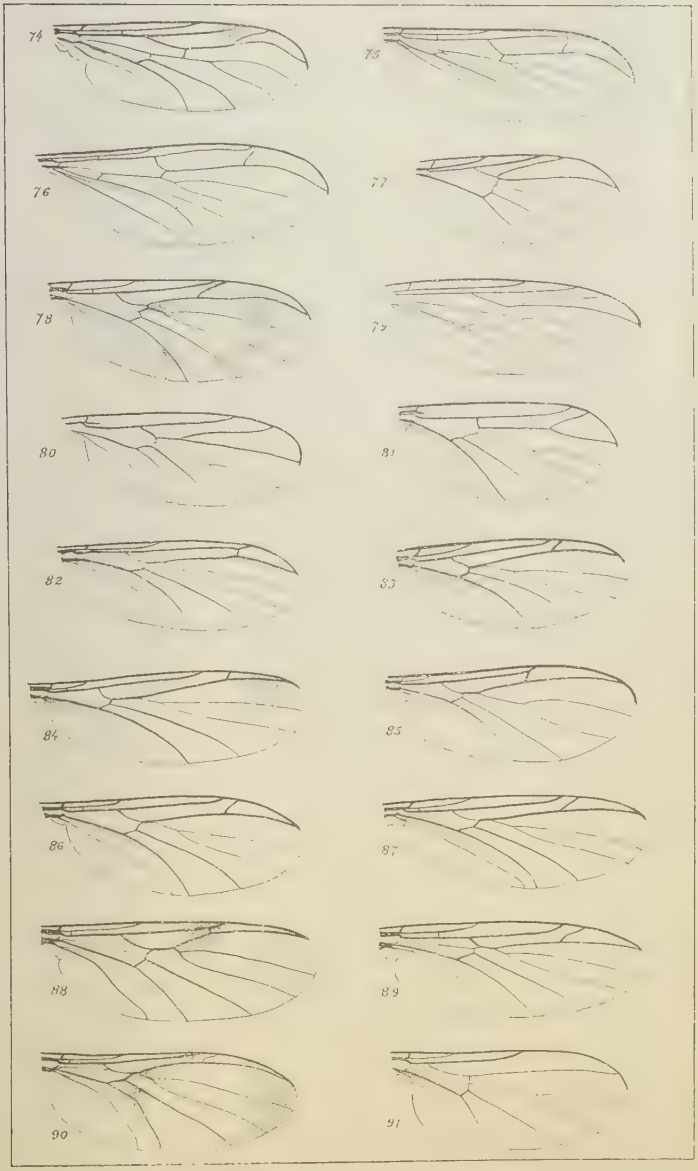
Fig. 74. Hesperinus brevifrons.
" 75. Bolitophila cinerea.
" 76. " disjuncta.
" 77. Mycetobia divergens.
" 78. Palaeoplatyura johnsoni.
" 79. Mycetophaetus (after Scudder).
" 80. Ditomyia (after Winnertz).
" 81. Symmerus tristis.
" 82. Ceroplatus clausus.
" 83. Cerotelion bellulus.
" 84. Platyura moerens, male.
" 85. " parva.
" 86. " setiger.
" 87. Asindulum montanum.
" 88. Apemon pectoralis.
" 89. Hesperodes (diagrammatic).
" 90. Macrocera clara.
" 91. Diadocidia ferruginosa.

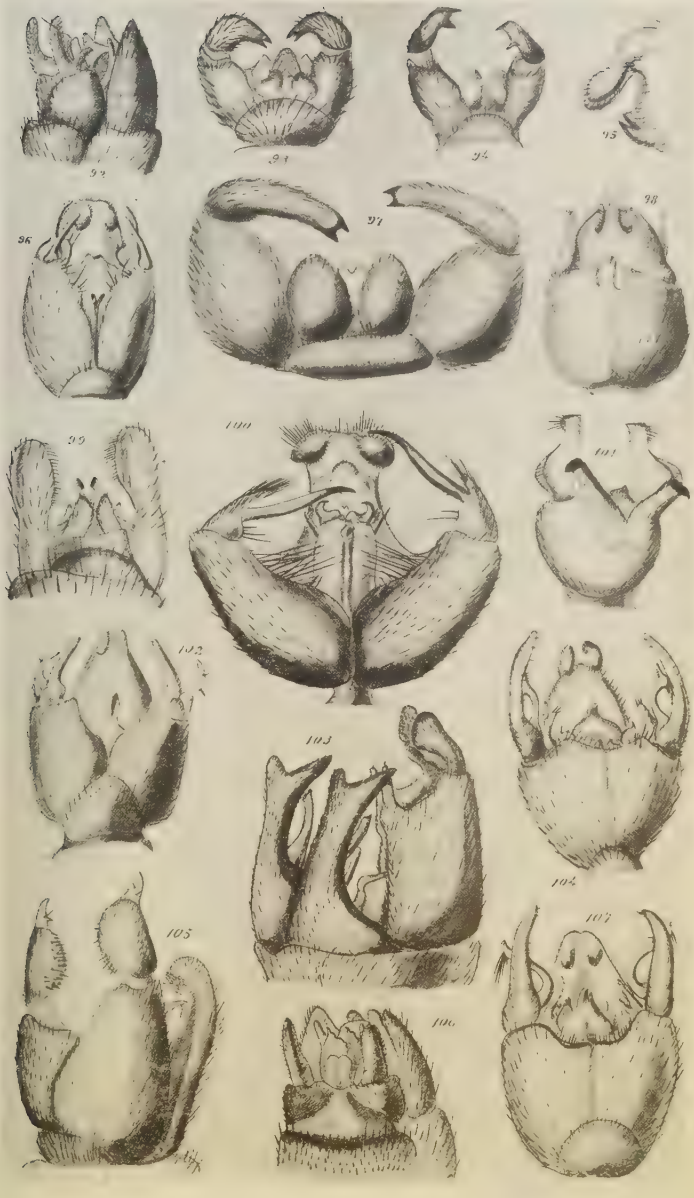
Plate.

Magnification 65 diameters.

Fig. 92. Platyura nigrita. Lateral aspect.
" 93. Macrocera formosa, var. indigena. Dorsal aspect.
" 94. " geminata. Dorsal aspect.
" 95. Platyura mendosa (female). Lateral aspect.
" 96. " moerens. Ventral aspect.
" 97. Apemon pectoralis. Dorsal aspect.
" 98. Platyura diluta. Ventral aspect.
" 99. " mendosa. Dorsal aspect.
" 100. " genualis. Ventral aspect.
" 101. " inops. Ventral aspect.
" 102. " fascipennis, var. sagax. Ventral aspect.
" 103. " setiger. Lateral aspect.
" 104. " subterminalis. Ventral aspect.
" 105. " scapularis. Ventral aspect.
" 106. " moesta. Ventral aspect.
" 107. " subterminalis, var. nexilis. Ventral aspect.




74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91


92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107

BULLETIN No. 173.

CHERMES OF MAINE CONIFERS*

By Edith M. Patch.

The Pine Leaf Chermes.

Chermes pinifoliae Fitch.

Chermes abieticolens Thos.

It is manifestly a pleasure to reinstate a species lost in a list of synonyms and an unusually interesting situation is found in the present study which justifies removing a species merged by error with two widely different Chermes† one on pine and one on spruce, and uniting these two forms in turn under the name of the form first described.

The species under consideration develops in a cone-like gall on the black spruce and migrates to the needles of the white pine to oviposite and was named, as commonly happens with aphids with two distinct host plants, separately in each situation.

The evidence concerning each will be taken in turn. Fitch's description of *Chermes pinifoliae*,‡ (though without figures or much structural detail) is excellent in that it selects several distinctly characteristic phases of this species and is sufficient to distinguish it from any of the other *Chermes* recorded in this paper.

Fitch's published account of the species is here given in full:

"267. Pine-Leaf Chermes, *Chermes Pinifoliae*, new species.

"Stationary upon the leaves, usually towards their ends, puncturing them and sucking their juices, a very small black fly 0.08** long to the tip of its abdomen, and 0.12 to the end of

---

* Papers from the Maine Agricultural Experiment Station: Entomology No. 39.

† *Chermes pinicorticis* and *Chermes abietis*.

‡ Trans. N. Y. Agric. Soc. 17: 741; id. Rept. Ins. N. Y. 4: 55, 1858.

** Fitch's measurements are given in decimals of inches.

its wings, which are dusky gray, its abdomen dusky red and slightly covered with fine cottony down.

"The females of these insects do not extrude their eggs. Clinging closely to the leaf with their heads towards its base, they die, their distended abdomens appearing like a little bag filled with eggs. The outer skin of the abdomen soon perishes and disappears, leaving the mass of eggs adhering to the side of the leaf, but completely covered over and protected by the closed wings of the dead fly. I have met with the dead females thus adhering to the leaves the first of July, and have noticed the same insects on the leaves in full life and vigor the middle of May.

"The rib vein of the fore wings runs straight to the outer margin forward of the tip, and gives off from its middle on the outer side a very oblique branch which runs to the outer margin, its tip producing a slight angular projection to the edge of the wing, and the whole space on the outer side of the rib vein beyond this branch is more opake than the rest of the wing and of a smoky yellowish color. From its inner side the rib vein sends off three simple oblique veins, the last one of which ends in the extreme tip of the wing. The hind wings have an angular point on their outer side beyond the middle, and a longitudinal rib vein, which, forward of its middle sends off a branch almost transversely inward, its tip curved backward. The antennae are short, thread-like, and composed of four or five small joints. It will hence be seen that this insect is a true Chermes—the first species of this genus that has been discovered in this country."

The fact that a *Chermes* described by Fitch as 0.08 inches long to the end of the abdomen (0.12 inches long to the tip of the wings) and the accurate and characteristic account of the place and manner of ovipositing on the pine needles could have been considered the same as *Chermes pinicorticis** for the past 40 years, is sufficient proof that none of the observers who have worked with *pinicorticis* have been familiar with Fitch's other species, i. e., *pinifoliae*.

---

* 1869, Shimer. Trans. Am. Ent. Soc. II, 383.
1884, Osborn. Bull. A. E. S. Ia. No. 2, 97-105.
1898, Storment, Rept. Ent. Ill. 20 iii-xxiii, pl. i-ii.

Thomas in his third report makes the following statement† concerning *abieticolens*.

"CHERMES (ABIETICOLENS?)

"Adeleges of the Spruce. Packard.

"A rather large species mentioned by Dr. Packard as 'found in abundance on the spruce in Maine, where it produces swellings at the ends of the twigs, resembling in size and form the cones of the same tree.' The specific name is applied provisionally and only for use in this report. This is certainly distinct from the European species *Chermes abietis* Linn., which is much smaller, of a bright reddish brown color, with the wings tinged with green."

Packard‡ reports this species as follows:

"37. The Spruce Bud-louse, *Adelges abieticolens*, Thomas.

"Deforming the terminal shoots of the spruce, producing large swellings, which would be readily mistaken for the cones of the same tree.

"We take the following account and illustration from our Guide to the Study of Insects:

" 'The genus *Adelges* was proposed by Vallot for certain broad, flattened plant lice which attack coniferous trees, often raising swellings on twigs like pine and spruce cones. The antennae are short, 5-jointed and slender; there are three straight veinlets arising from the main subcostal vein and directed outwards, and there are no honey tubes; otherwise these insects closely resemble the Aphides. A species closely related to the European *Adelges* (*Chermes*) *coccineus* of Ratzeburg, and the *A. strobilobius* of Kaltenbach, which have similar habits, we have found in abundance on the spruce in Maine, where it produces swellings at the ends of the twigs resembling in size and form the cones of the same tree. We would add that each leaf-bud is enlarged, having an *Adelges* under it. As those nearest the base mature first and leave their domicile, the deformed leaf-bud stands out from the axis of the shoot, thus giving the conelike appearance to the end of the shoot.'

"This has since been described by Prof. Cyrus Thomas in his Third Report on the Injurious Insects of Illinois, p. 156."

† Rept. Ent. Ill. 8: 156, 1879.

‡ Insects Injurious to Forest and Shade Trees.

That Packard himself was familiar with the galls of both *abieticolens* and the European *abietis* and considered them distinct is shown by his item which follows the foregoing one just quoted:

"38. The European Spruce Bud-louse, *Adelges abietis* Linn.

"We observed this species in considerable numbers on the Norway spruces on the grounds of the Peabody Academy of Science at Salem, in August, 1881. The deformation produced in the terminal buds and twigs were like those figured in Ratzeburg's Die Waldverderbniss, Bd. i, Pl. 28, figs. 1, 2."

Thomas states that he was certain that he was dealing with a distinct species, and one brief item is sufficient to prove him correct, for he uses one difference which is alone enough to separate these two species when he says that with the European species, *Chermes abietis* Linn. "the wings are tinged with green". While color distinctions are often an unsafe basis, it is steadfast one here, for *Chermes abietis* has uniformly and conspicuously green wings while the dark species developing in that Spruce gall ("found in abundance on the spruce in Maine") which when deserted "stands out from the axis of the shoot, thus giving the cone-like appearance to the end of the shoot" has the stigmal region reddish brown, or 'smoky yellowish,' and never at all greenish either when newly emerged from the gall or upon aging.

It seemed desirable in a circumstance so complicated to give, before presenting original data, the historical situation for the species under consideration, which develops in a cone-like gall on the black spruce (in which connection it was named *abieticolens* in 1879 by Thomas and subsequently merged by error with *abietis**), and migrates to the needles of the white pine (in which connection it had been previously named *pinifoliæ* by Fitch, 1858, and merged by error with *pinicorticis*† in 1869 where it has remained for 40 years in oblivion).

---

* Fernald and Cooley, 34th Report Mass. Agric. College 1897, pp. 89-100.

† Shimer, Trans. Am. Ent. Soc. 2: 383.

CHERMES PINIFOLIAE IN MAINE.

On June 16, 1905, I first found winged *Chermes* in great abundance on the needles of white pine (*Pinus strobus*) at Orono. My notes for that date state that on some branches nearly every pine needle had a *Chermes* stationed near the tip with the head away from the tip. On some needles were three or four. Most of the specimens observed at this date were dead. A large cluster of eggs was found beneath the wings of each *Chermes*. Eggs brought in June 16 hatched June 26.

Immediate reference to Fitch's description gave such a striking agreement of my notes with his account of the egg laying habit of *Chermes pinifoliae* that I listed the collection under the name of that species. Mounts were made of the freshest specimens a few of which were still alive. These I took with considerable other material to Mr. Pergande the following winter and he kindly compared them with Fitch's type* of *Chermes pinifoliae* and stated that the type specimen was too imperfect to give a satisfactory basis of comparison but that in size and in such points as could be compared the two agreed and that he considered the specimens from Maine to be *pinifoliae*.

July 5, 1907, at Milo, Maine, I observed this species very abundant on the needles of white pine. The specimens were all dead at this date but they still adhered to the needles, on some of which there were as many as 14 or 16 in Indian file with their heads towards the base of the needle. This was in accordance with Fitch's observation "I have met with the dead females thus adhering to the leaves the first of July." Specimens of this collection were photographed as taken. See Fig. 127.

On June 14, 1909, a large number of black spruce twigs were brought to me with the statement that "almost every *cone* is infested under the scales and is abnormal in form." Some of these specimens are shown in Figs. 128 and 129. The infested growths at this stage were indeed so cone like that I took their coneship for granted until I read over Packard's discussion of *abieticolens* Thomas which he "found in abund-

* Fitch's aphid types were originally mounted on card points on pins. A few of these came finally to the U. S. collection where they were removed and are preserved as balsam mounts.

ance on the spruce in Maine, where it produces swellings at the ends of the twigs resembling in size and form the cones of the same tree." Dissection of the galls, of course, proved they were not abnormal *cones* but abnormal *shoots*.

The mistaken identity of the so-called "cones" seemed a good joke entomologically and as the collector of the galls is a plant morphologist perhaps not less so botanically.

Both the galls and the *Chermes* in them are distinct from *abietis* and there seems no ground for doubting that this species is *abieticolens*.

Some of the more advanced galls of *Chermes abieticolens* were opening on date of collection, June 14, and by June 21 fresh *Chermes pinifoliae* were on the needles of White Pine everywhere in the neighborhood of Orono. Others were sent in from other parts of the state a little later. Accompanying such specimens from Gilead vicinity on June 25 "millions of the flies on white pines" were reported.

As the disappearance of the emerging *abieticolens* from the spruce coincided exactly in time with the appearance of *pinifoliae* on the white pine and as there was no apparent difference in the *Chermes* in these two situations the conclusion was obvious enough and careful microscopic comparison was, of course, made. There was no difference between the two discoverable in any structure submitted to this sort of examination. The freshest of the specimens on the white pine had of course to be used for the comparison.

A check migration test was made June 22. A lot of galls from the black spruce were placed in a cage with fresh twigs of various conifers. On June 25, more than 200 individuals had settled on the white pine where they remained with their eggs. Although specimens were found crawling over some of the spruce twigs supplied them no individual settled and oviposited except on the white pine. This was more overwhelming preference than is usual with a cage test, for often in confinement a few stray specimens oviposite amiss, as it happens also to insects in the open. Perhaps if the test had been prolonged some of these would, but three days with the uniform result of 200 to 0 seemed sufficient.

In confinement, as in the open, these *Chermes* settled on the pine needles with the head toward the base of the needle. Out

of the thousands seen this season only very rarely was one found headed in the other direction. In confinement as in the open this species did not "oviposite" in the usual sense of the term, as the eggs were not expelled. As Fitch himself accurately recorded what I have observed three seasons (1905, 1907, 1909*) "the females of these insects do not extrude their eggs. Clinging closely to the leaf with their heads towards its base, they die, their distended abdomens appearing like a little bag filled with eggs. The outer skin of the abdomen soon perishes and disappears, leaving the mass of eggs adhering to the side of the leaf, but completely covered over and protected by the closed wings of the dead fly." Such an egg cluster comprises about 100 eggs.

The eggs of the *Chermes* which settled on the pine needles June 22-25, in the cage migration test recorded, were hatching July 3, in conspicuous numbers.

These young, the progeny of the migrants, settle at the tips of the new pine shoots where by the latter part of July their presence is rendered conspicuous on account of the white waxy secretion of the *Chermes*. This secretion gives a white woolly appearance to the infested portion similar to but much less dense than that of *pinicorticis* on the trunk of the white pine.

Where the infestation is heavy it causes a yellowish and sickly appearance of the new growth which is thus considerably stunted. As will be seen by Fig. 132 taken July 23, 1909, the new needles are not at this time full grown. The new needles on twig photographed were yellowish for a part of their length and the whole tip of the twig had an unhealthy appearance.

It will be seen from the date of the flight of this species from the spruce galls to the pine, about June 15-21, that the pine leaves on which they settle to oviposite are those of previous years growth, that is, the needles of 1909 have not started sufficiently for the *pinifoliae* of June 1909 to use.

This fact is in contrast with a second species, *Chermes floccus*, migrating from black spruce galls to pine needles late in July

*I am not able at present to state whether there may be any significance in this once in two years collection or not. I had not been paying any particular attention to *Chermes* and they may have been present in considerable numbers the other years also, and I had merely neither collected nor recorded them. The notes as they stand suggest a two year cycle but no observations as regard to this are yet available.

and ovipositing both on old growth and new growth needles. There is no reason for confusing *pinifoliae* with this second species as the discussion of the latter will make plain.

On May 19, 1908, I found *Chermes* pupae common on terminal shoots of white pine. My notes for this collection read: "The pupae are massed close to the tip of the stem or at the base of needle cluster on some stems, and on others they occur singly at the same locations. They are downy enough to be noticed but are not very flocculent."

I collected a considerable number of twigs and the next day many of the pupae molted and an abundance of winged adults were secured. These I listed at the time as *pinifoliae*, and on going carefully over this preserved material this fall I can see no reason to separate it from the species which matures in the black spruce gall about the middle of June. Antennal, wing, and leg characters are apparently identical and the gland areas are so faintly indicated as to ally it with this species and separate it from any other taken in Maine.

These mid-May *Chermes pinifoliae* are, I believe, the return migrants from pine to spruce, but I have not observed this migration. They are not the generation that oviposites on the pine needles, however, as this is done by the migrants from the spruce. This collection, May 19, it will be seen, is in accordance with Fitch's statement that he had "noticed the same insects on the leaves in full life and vigor the middle of May."

It will be seen from the dates of the migrants that either the time which *pinifoliae* spends on the spruce is very short—four to six weeks—or that a two year cycle is required. It is not at present possible to say which is the case.

The galls are uniform, regular, and cone-shaped in form. In length they vary when full grown from about three-fourths to one and one-half inches. Under the stimulation of the *Chermes* the new growth at the tip of the twig is modified and the twig tip develops into a cone-shaped object. The stem itself is not much swollen. Each needle becomes a scale, broadest at the middle and concave on the inner surface. Beneath each scale-like leaf a single Chermes develops. Packard states that in the gall of *abieticolens* "each leaf bud is enlarged having an *Adelges* under it" which statement in itself would distinguish

such a gall from that of *abietis* each cell of which contains not "*an*" but *many* individuals. A single gall of *pinifoliae* not under average size which I dissected was found to be composed of 139 scale-like leaves under each of which was a single pupa.

The gall when young is slender, about the same length as the young cone and often about the same purple color. Fig. 129 shows a black spruce twig with a single young cone at *A*, the tip of which is unfortunately broken; at *B* are four normal spruce tips; at *C* are four young galls of *pinifoliae*. This photograph shows very well the distinguishing feature of these three growths, the normal shoot, the modified shoot or *Chermes* gall, and the normal cone.

Fig. 128 shows a fully developed gall which at this stage is green. After the galls lose their first purple color they remain green until the time of the emergence of the migrants. Fig. 130 shows the normal cone at *A* which at this stage is purple, at *B* the normal shoot which is green, at *C* the deserted gall which is bright reddish brown. After the gall is deserted the gall leaves flare out from the stem, leaving the chambers open wide. About this time the gall becomes a bright reddish brown, that is the galled terminal shoot dies in this characteristic way.

Pupa. The full grown pupa (June 14) is dark reddish brown with thorax somewhat lighter than head and abdomen. Legs and antennae dusky. Body lightly threaded with short wax fibers, giving body a downy appearance.

Winged Female. Fig. 108. The newly molted migrant, before the wings are expanded, is glistening reddish brown with pellucid legs and antennae. The crumpled wings are distinctly yellow. The wings when expanded are smoky, the stigmal region is yellowish or reddish brown. The migrant by the time it has reached the pine needles is very dark, with "its abdomen dusky red and slightly covered with fine cottony down." The antennae and legs are dark. In size these migrants vary greatly as indeed do all the *Chermes* listed in this paper. The total length of body of this form ranged from 1.7 mm. to 2.9 mm. (.066 in. to .11 in.) the latter measurement being for the larger individuals with their abdomens fully extended. The wing expanse varies also, the average being about 8 mm. There

is nothing especially striking in regard to the venation. The characteristic curves of the veins have been faithfully reproduced (Fig. 108). At the junction of *Sc* with costal margin the wing creases a little and a decided angle occurs at that point in the wings of this species except when they are newly emerged. This angle is more pronounced for this species than any other of these Maine species, though the same tendency is often shown by others to a slighter degree. The drawing was made from a wing of a newly emerged individual and this costal angle not indicated.

The most distinctive characteristic in the wings of *pinifoliae* is the decided arch of the costal margin of the fore wing and the almost circular curve of the hind margin of the hind wing. The shape of the wings alone would separate this species from the other five developing in spruce galls in Maine. Packard's figure of *abieticolens** gives the characteristic outline of this peculiar wing which alone would serve to separate it from *abietis*. The legs are very stout.

The antennae (Fig. 109) are 5-jointed, the segments stout, III, IV and V are approximately subequal in length. III and IV resemble each other closely both as to shape and sensorial areas. V has the curve of the outline less abrupt, and the sensorial area larger. Terminal hairs four or five in number and slender (Fig. 109a). The sensorial areas as well as the shape of segments and reticulations are shown in the figure of antenna more distinctly than verbal details could indicate.

The wax pores of this species are more difficult to find than on any of the other species recorded in this paper. Even in specimens fairly well cleared the gland areas were not always evident. However, from a large series of mounts of specimens cut transversely giving the clearing fluids every opportunity, the gland areas (Fig. 108) were found to be consistently as follows: head with an area of two transverse groups on anterior margin nearly coalescing, an area of two transverse groups at posterior margin; prothorax with an irregular lateral area, a median anterior area of two groups, and a row of 4 groups near posterior margin; mesothorax with a lateral group on anterior margin and a median area of two groups on posterior portion

* Insects Injurious to Forest and Shade Trees.

of the lobes; metathorax with a median area of two groups corresponding to the median rows of the abdomen; abdomen with median area in two groups (or frequently merging) on segments 1 7, and a lateral group on segments 1 9 (merged on the ninth). In addition to these there occurs between the lateral and median groups on segments 1-4 a very small group of two or three pores usually separate from the median pores, but sometimes merged with them. Most, if not all, of these wax pores would easily be overlooked and the fact that this species has its abdomen only "slightly covered with fine cottony down" indicates that the glands are not so functionally active as those of other species.

Remedial Measures. There would seem to be no practical method of combatting this insect in forest growth. With ornamental trees, however, the galls could be removed from the black spruce previous to the emerging of the winged form. Also if the species proves constantly troublesome it might be desirable not to plant the white pine in the vicinity of black spruce and *vice versa.*

Spraying with whale-oil soap (1 pound to 2 gallons of water), would probably destroy the young on the white pine shoots, but it is doubtful that this would be usually worth while in Maine where Syrphus flies abound. The larvae of these, little light colored maggots, have been found to feed industriously on the young Chermes. So numerous are these beneficial maggots at times in the midst of the white waxy secretion of the Chermes that they are sometimes mistaken by people submitting them for determination as the cause of the trouble.

Note: The foregoing evidence will make it clear enough that Shimer was in error in considering the winged specimens which he reared from *pinicorticis* to be *pinifoliæ.* That Shimer found winged *pinicorticis* "very plentifully" on the pine leaves would be natural enough for at the time of emergence the winged forms are sometimes abundant on all parts of the tree. I have seen them in considerable numbers resting on pine needles apparently just before flight, but never fixed as described by Fitch as characteristic of *pinifoliæ.* Observers of *pinicorticis* have accepted Shimer's conclusions that his *Chermes* .025 inches long which he bred from pupal *pinicorticis* was the same as *pinifoliæ* described as .08 inches long, in spite of the fact that they have had to contradict Fitch's explicit observations in regard to the very characteristic habits of *pinifoliæ.* With the meagre descriptions of the early aphid records many such mistakes are scarcely avoidable, in absence of the species

itself. Fitch's comments on *pinifoliæ,* however, are distinctive enough so that with his species in hand it no longer seems "singular" and "unfortunate" that he described *pinifoliæ* as distinct from *pinicorticis,* but rather singularly interesting that this species had not been rediscovered long ago.

To see that Fitch's much discussed description of the wing of *pinifoliæ* agrees with fig. 108 it is only necessary to translate it to modern parlance "The rib vein (Rs) runs straight to the outer margin forward (proximad) of the tip, it gives off from its middle on the outer side a very oblique branch (Sc) which runs to the outer (costal) margin, its tip producing a slight angular projection* to the edge of the wing, and the whole space (stigma) on the outer side of the rib vein (Rs) beyond this branch (Sc) is more opake than the rest of the wing and of a smoky yellowish color. From its inner side the rib vein (Rs) sends off three simple oblique veins, the last one (M) of which ends in the extreme tip of the wing. The hind wings have an angular point (for hooks) on their outer side (costal) beyond the middle, and a longitudinal rib-vein (Rs) which forward (proximad) of its middle sends off a branch (M) almost transversely inward (caudad) with its tip curved backward (distad)."

1858. *Chermes pinifoliae* Fitch. *Trans. N. Y. St. Agr. Soc.* for 1857, *Vol.* 17, 1858, *p.* 741. Republished in *4th Rep. Ins. of N. Y.* 1859 *p.* 55.
Description of winged form.

1862. B. D. Walsh. *On the Genera of Aphididae Found in the U. S.* Species listed only.

1869. Henry Shimer. *Trans. Am. Ent. Soc., Vol.* 2, *p.* 384. Winged forms of *pinicorticis* mistaken for *pinifoliae.*

1879. Cyrus Thomas. *Eighth Rep. St. Ent. of Ill., p.* 156. Quotes Fitch's description.

1881. A. S. Packard. *Insects Injurious to Forest and Shade Trees. p.* 118. From Fitch.

1884. Herbert Osborn. *Bulletin No.* 2. *Iowa St. Agr. Coll. Dept. of Ent.* Follows Shimer's error in considering winged *pinicorticis* to be *pinifoliae.*

1885. J. A. Lintner. *2nd Rep. St. Ent. of N. Y., p.* 180-187. Follows Shimer's error in considering winged *pinicorticis* to be *pinifoliae.*

1890. A. S. Packard. *Fifth Rept. U. S. Ent. Comm. p.* 805. Fitch's description quoted, without comment.

---

* See page 286 for comment.

1898. Storment. *Rept. Ent. Ill.* 20; iii-xxiii. Follows Shimer's error in considering winged *pinicorticis* to be *pinifoliae.*

1901. W. D. Hunter. *Iowa Agric. Coll. Exp. Sta. Bull.* 60. *The Aphididae of North America.* Lists *pinifoliae* as a synonym of *pinicorticis.*

1909. Edith M. Patch. *Annals of the Ent. Soc. of Am. Vol. II. No.* 2. Discussion of tracheation of wings of *Chermes pinifoliae.* Pp. 107, 111, 116 and figs. 26-30.

1909. Edith M. Patch. *Me. Agric. Exp. Sta. Bul. No.* 171. Economic treatment giving main features of life history of *pinifoliae* and stating that *abieticolens* is the gall generation of the same species.

1909. Edith M. Patch. Psyche Dec. 1909, pp. 136-137.

Chermes abieticolens.

1869. A. S. Packard. *Guide to the Study of Insects, p.* 522. Brief description with figures of this species recorded as a species of *Adelges* occurring in abundance on the spruce in Maine. Some good characters of gall also given.

1879. Thomas. *Rept. Ent. Ill.* 8: (*III of Thomas*) *p.* 156. Species named provisionally as *Chermes abieticolens* and statement made that it is certainly distinct from *abietis.* Refers to Packard.

1885. J. A. Lintner. *2nd Rep. St. Ent. of N. Y., p.* 185. Refers to Packard and Thomas.

1887. Oestlund. *Aph. Minn.* Species listed.

1890. A. S. Packard. *Fifth Rep. U. S. Ent. Comm. Adelges abieticolens* Thomas. Original account and illustration copied.

1897. Fernald and Cooley. *34th Report Mass. Agric. College, pp.* 89-100. *abieticolens* merged with *abietis* by error on the basis that in response to "about five hundred circular letters sent to different persons in the U. S. and Canada, only one species of *Chermes* was received." Excellent account of *abietis.*

Chermes abietis Chol.

This common European species has been variously designated as "The Spruce Gall-louse"*, "The European Spruce Bud-louse"†, "The Yellow Chermes"‡, "The green-winged Chermes"** and the gall has been aptly called the "pine-apple gall" on account of its form.

This species has been for a good many years annually abundant on the Norway and white spruces on the campus of the University of Maine. I have collected the gall and the insect at various stages frequently since the fall of 1903, without giving the species any especial study except to compare my own observations with published accounts.

Confusion in the literature of this species both in this country and in Europe has existed on account of other species having been confounded with it. Because of this it may not be out of place to present my own notes, though probably containing no new observations, in connection with the photographs of the galls and the drawings of the species which they concern.

The Gall. Fig. 137. The galls of *abietis* vary in size from about ½ inch to 1 inch or more in length. They occur at the base of terminal shoots and do not as a rule kill the twig. Where they are numerous they cause serious deformations of the branches, and small trees are sometimes ruined by their presence. Such galls are not only very abundant on Norway spruces but they are troublesome on the native white spruce in Maine. This season (1909) a single white spruce 3 feet tall had more than 990 fresh galls upon it. The growing galls are green, with the closed mouths of the cell marked by a V-shaped red line. The shade of this line varies from purple to brick red in different galls and at different times. The galls resemble in form a little pine-apple, each section being represented by a needle much enlarged at the base and little if at all at the tip. The relation of the galls to the twig on which they grow is shown in the longitudinal sections in Figs. 138 and 139. It will be seen that in some cases the gall entirely encircles the twig which

* 34th Report Mass. Agric. College.

† Packard, 5th Report of Ent. Comm. page 853.

‡ Die Coniferen-Läuse Chermes. Prof. N. Cholodkovsky. 1907.

** Me. Agric. Exp. Sta. Bul. 171.

continues its growth from the apex of the gall, while in others the gall is produced in a one sided manner only partly encircling the twig. The cells of the gall are closed. A sample gall about ¾ inches long contained about 50 cells each holding from 8 to 12 nymphs. This count was made August 13.

About the middle of August at Orono the mouths of the cells open and the pupae emerge to molt.

Nymphs, the Gall Generation. Specimens taken from galls June 23, 1904, are recorded as greenish yellow. July 24, 1909, nymphs are recorded as very pale yellow covered with white pulverulency. Molted skins attached to caudal extremity were filled with liquid so as to retain their shape. Many nymphs had two such molts attached so that three successive stages of the insect were in line. The excreted liquid being largely disposed of in this manner, the cell wall of *abietis* is clean and dry, a condition made further possible by a slight covering of waxy powder.

Pupae. Body length of full-grown pupa 1.9 mm. Specimens taken from galls on Norway spruce August 4, 1909, were very pale yellow, slightly pulverulent. Others taken from galls on white spruce August 17, 1909, were a little darker yellow and the finely pulverulent abdomen had a slight rosy tint. The pupae leave the galls before molting. The time of most plentiful emergence is from about the middle to the last of August for the vicinity of Orono, though the galls in more exposed sunny places are about a week earlier in opening than the average shaded ones. The pupae creep from the open cells of the galls in a sluggish manner and often rest in Indian files on the needles near the gall, where they molt and become the winged individuals. The cast skins remain in white rows upon the needles for some time unless dislodged by rain. See Fig. 140.

The wax pores for the pupa are: (Fig. 117) head with an anterior group of pores near base of each antenna and two median groups at posterior margin; prothorax with lateral gland area, an anterior median pair of groups, a small group (4 pores) between the lateral and median ones, and four groups near posterior margin of prothorax; mesothorax with an anterior lateral area; metathorax with two separated median groups; abdomen with small and widely separated median groups on segments I-VI, those on I being composed of about 6 pores,

those on II of 3 and those of III-VI of 2 each, a very small group of lateral pores occur on segments II-IX (merged to a caudal group on IX), and about half way between the median group and lateral margin an additional group of about 3 pores occurs on segments I and II. The smallness of these inconspicuous groups is correlated aptly with the fact that this is not a flocculent species, the wax secretions not exceeding the pulverulent condition. Fig. 117 shows a pupa a short time before the final molt.

Winged Oviparous Form. Fig. 115. The freshly molted individuals, August 19, 1909, have a golden brown body, the thorax, except the dorsal lobes, slightly lighter than abdomen, lobes of thorax dark, head dark, wings with whole stigmal area and margin a decided and conspicuous green, the remainder of the wing being white with a slight yellowish green tint. As the individual ages the coloring becomes darker, though the wings retain their characteristic green color. Length of body 1.7 to 2 mm., wing expanse 6.mm.

The areas of the wax pores (Fig. 115) are much as in the pupa except for the abdomen which is as follows: I with median groups comparatively large and merged, II median groups separated and composed of 2 pores each, V with two small groups between median ones referred to. I-VIII with distinct lateral groups on darkened area, III-VI with small groups of 2 or 3 pores each midway between median and lateral groups.

The wing veins of this species have, as with the other five discussed in this paper, a fairly constant characteristic trend which is shown in Fig. 115. First A of the fore wing is seen to be considerably arched.

The sensorium of each of antennal joints III-V is confined to the distal half of the joint and extends not more than half way around the joint. These three joints are much alike in general appearance. III is noticeably shorter than IV while IV and V are subequal. The usual group of smaller sensoria occurs on V and there is nothing striking about the 4 or 5 terminal hairs. Fig. 116.

Apterous oviparous form—winter female or stem mother. May 7, 1906, I observed these young females of the winter generation, minute and slightly downy clinging close to the buds or in the axle of the leaves on Norway spruce. May 31, 1906,

the females were very plentiful and were readily detected on account of the little white flocculent mass surrounding her and her recently laid eggs. One such egg cluster contained about 140 eggs and the female was not through ovipositing.

The life cycle for *abietis* based upon the writer's observations is briefly as follows: Galls open about mid-August and fully grown pupae emerge and molt within a few hours becoming the winged form which deposits a cluster of 40 to 50 yellow eggs on a spruce needle. The eggs are extruded from the abdomen but the parent *Chermes* remains over them until dislodged after her death by wind or rain. The winged form often oviposites near the gall from which it emerges. A different species of host plant is never sought by this *Chermes*. In about two weeks the young "stem mothers" hatch from these eggs and seek a protecting crevice in the surface of the spruce bud where they can spend the winter. These wingless forms develop in the spring and become full grown about the last of May when they lay a cluster of 140 or more eggs. From these eggs hatch the young that inhabit the gall and are known as the "gall generation" with which we started the cycle.

For a further account of *abietis* the reader is referred to the *34th Report of the Mass. Agric. College*, 1897, and to *Die Coniferen-Läuse Chermes* by Prof. N. Cholodkovsky, 1907.

Remedial Measures. Spraying the trees in April with whale-oil soap solution (1 pound to 2 gallons of water) has been reported as effectual. (34th Report Mass. Agric. College). The practice of removing and burning the galls will serve to control this species sufficiently on ornamental trees. At Orono great numbers of the winged forms are caught in spiders webs that are spun irregularly over the spruce twigs.

Bibliography. It does not seem practical to attempt a bibliography of *Chermes abietis* for United States. That various other *Chermes* have been confused with this species is certain, but to what extent it is often impossible, on the basis of the references, to be sure. The illustration in Bulletin 56, West Virginia Agricultural Experiment Station 1899 of the "Galls and deformed twigs of the spruce gall louse" (Fig. XXXI, page 261) does not figure galls of *Chermes abietis* but those of some other *Chermes*, possibly of *similis*.

In the Spruce Gall-louse *Chermes abietis* Linn. by Fernald and Cooley (34th Report Mass. Agric. College, 1897) is pre-

sented carefully the life history and habits of this species. The figure of the gall Plate II in that paper is the characteristic *abietis* gall and the wings on the same plate show the typical curves of the veins of this species. The record of *abietis* from Colorado (page 4 of Author's separata p. 92 in 34 Report) however applies to *Chermes cooleyi* (See Gillette *Chermes of Colorado Conifers* page 3), and *abicticolens* of Packard and Thomas is by error in that publication considered to be the same as *abietis*.

Chermes lariciatus Patch.

A gall resembling that of *abietis* very closely in size and form and found, like that of *abietis*, on white spruce was taken in the vicinity of Orono by Mr. William Woods, July 28, 1909. Fig. 141 shows two of these.

The galls. Like the galls of *abietis* they are not terminal on the twig and the tip of the twig extends out from their apex when they encircle it, or along one side of the gall when they do not, just as with *abietis*.

The galls were mature on date of collection. The needles of the gall are green at this season. Conspicuous wide russet lines mark the closed mouths of the galls which gives the gall a general russet color. The needles of the gall are much shorter than is usual with *abietis* on the Norway and White spruces and it is thus a little more pine-apple like in form than *abietis*. Many of the galls were opening at the time they were collected, and the pupæ walk out from the open cells before they molt, as do *abietis*. The galls become dry and brown soon after they are vacated. The cells are not as shallow as those of *abietis*.

The pupa. (Fig. 122). Described from forms just leaving the gall before the last molt. Length of body 2 mm.; head, prothorax and abdomen light reddish; thorax yellowish green; wing pads dark green; ventral prothorax and thorax yellowish green; legs and antennae greenish. The areas of wax pores are well defined; head with anterior area between antennae, and four posterior groups; prothorax with a large lateral area, an anterial row of 4 groups, a posterior area of 2 groups, and a broken line of 4 groups between the anterior and posterior groups; mesothorax with a very large anterior lateral area and a row of 4 groups across the middle of the segment; metathorax with a very large lateral area about the size of that

of the mesothorax, and a row of 4 well defined and separated groups which are in line with those of the abdomen; abdomen with lateral groups on I-IX (merged to caudal group on IX), I-VI with a dorsal row of 4 groups on each segment, the median ones being largest but not merged.

The Winged Oviparous Form. Migrant. (Fig. 118). Newly molted individuals have prothorax and abdomen light yellowish brown, head and thoracic lobes dark, legs and antennae greenish, wings decidedly green with yellow proximal portion The individuals, of course, grow darker as they age. Body length about 1.9 mm.; wing expanse 6 mm. to 6.2 mm.

The well defined areas of wax pores are: head with 2 distinct anterior groups and 2 large and separate posterior groups; prothorax with the usual lateral area, a row of 4 anterior groups, and 2 posterior groups widely separated, mesothorax with two median distinct groups; metathorax with two median groups separate and in line with the median groups of the abdomen; abdomen with median groups on segments I-VI well defined and widely separated, well marked lateral groups on segments I-IX (merged to caudal group on IX), and a small group between the lateral and median groups on III-VI.

The antennae (Fig. 119), is more like that of *abietis* than any of the other species of this paper, but the outlines of the joints are less abrupt, the curves of the sensoria are more regular, and V is typically longer than IV. III and IV are about subequal.

The wings resemble those of *abietis* but are distinct enough. 1st A of the fore wing of *lariciatus* is less strongly arched and M of the hind wing is a heavier vein than that of *abietis* and strongly curved with the convexity distad.

July 31, 1909, this species was found to be common on the needles of larch everywhere in the vicinity of Orono. The migrants from the white spruce galls settled on the larch needles and oviposited. The eggs are extruded and not retained in the abdominal cavity as with *pinifoliae*, and the parent is more easily dislodged even than *abietis* and soon drops from the egg mass. There are from 50 to 75 beautiful green (paler than larch green) eggs in a cluster. (Fig. 121). They are slightly pulverulent. The glimpse through a glass at this little *Chermes* with the green eggs showing through her transparent wings

is one of the prettiest sights of the insect season. Fig. 120 gives the position of this species when oviposition is nearly finished. The migrants settle on the larch needle either with head toward base of needle or toward tip, apparently indifferently.

On July 31, 1909, opening galls of this species were placed upon sprigs of conifers in cage. The twigs were in vials of water so that they remained fresh. On August 3 the individuals that oviposited were counted with the following results:

Picea rubra Dietr	Red spruce	0
Picea mariana (Mill.) B. S. P.	Black spruce	0
Picea abies (L.) Karst	Norway spruce	1
Picea canadensis (Mill.) B. S. P.	White spruce	4
Pinus strobus L.	White pine	0
Pinus sylvestris	Scotch pine	0
Thuya occidentalis L.	Arbor Vitae	0
Abies balsamea (L.) Mill.	Balsam fir	4
Larix laricina (Du Roi) Koch	Larch	69

The preference for larch speaks for itself. Whether the other ovipositions have any significance or are merely accidental it is, on the basis of this one test, impossible to say.

Whether *lariciatus* may be the same as *laricifoliae* Fitch I have not been able to decide. There is nothing in the brief description of Fitch's to preclude this possibility. Fitch's color description does not agree in all respects with my notes for *lariciatus* but these were made from specimens immediately after molting and would not be the same as an older specimen. The italisized portion of the original description for *laricifoliae* Fitch which is here quoted entire would apply very well to *lariciatus*. "*Solitary and stationary upon the leaves, extracting their juices, small* black shining flies *0.10* (*inch*) *long*, having the abdomen dark green, *the legs obscure whitish, the wings nearly hyaline with pale brown veins and the large stigma-spot upon their outer margin beyond the middle more opake and pale green.* This is closely like the Pine Chermes, No. 267, but *has the wings more clear, and differs also in some of the details of its colors.*"

So far as I can judge some of the records referred to *laricifoliae* in this country really concern *consolidatus* which is certainly not *laricifoliae* Fitch. It is not improbable that *lariciatus*

may prove to be the European *viridis* Ratz. as discussed by Professor Cholodkovsky in *Die Coniferen-Läuse*, 1907. The galls of *viridis* Figs. 1 and 8 in that publication very well picture the galls of *lariciatus* and the host plants are identical.

As the specific characters on which I have laid most stress, antennae, wings and wax gland areas of the winged forms, are not given in so much detail in European publications as the structure of the apterous forms, the figures do not emphasize the same points and the only basis for comparison would be determined European material which may perhaps be possible to secure.

CHERMES CONSOLIDATUS Patch.

July 20, 1909, in the vicinity of Orono Mr. William Woods collected from black spruce some pink and green galls resembling those figured by Professor Cholodkovsky in *Die Coniferen-Läuse Chermes* 1907 for *Chermes strobilobius* Kalt. The flesh of the gall on the surface is a delicate pink, the needles of the gall, much stunted, are a delicate green. Some of the galls collected on the same day were pale green instead of pink. The galls (Fig. 145), are about one-half inch long or less and are terminal. The cells of the galls contained dark red nymphs which were flocculent rather than merely pulverulent, and the cell walls were also covered with the flocculent secretion.

Specimens began to emerge from these galls in the laboratory July 30, and galls found out of doors on red spruce were opening about the same time.

Opening galls of this species were placed in a cage on twigs of red spruce, black spruce, white spruce, Norway spruce, arbor vitae, white pine, Scotch pine, hemlock, balsam fir and larch. In a few days a count of ovipositing individuals was made and it was found that they had laid eggs *very sparingly* on each of the four spruces and balsam fir —1 to 5 specimens on each plant. 9 to 12 eggs were deposited in a mass under the wings. Most of the individuals died without ovipositing at all. This test certainly gave no dependable data, nor did I chance upon this species ovipositing out of doors. The galls in this vicinity were not numerous and the species is very small.

I have taken, however, on June 20, 1909, and about the same time previous years small *Chermes* pupae developing at the

base of larch cones in flocculent matter. When these molt they prove to be brown bodied with a caudal flocculent tuft and greenish wings. These winged forms I am unable to separate on microscopic comparison from *consolidatus* (Figs. 123 and 124), and think that there is no reason to doubt that they are the same species, and that the larch and spruce are alternate hosts of *consolidatus*.

Whether they prove to be *strobilobius* Kalt. can only be ascertained by comparison with authentic European material which is not at present available.

Pupa. The pupa, described from specimens removed from spruce galls. -(Fig. 125). Body dark red and flocculent, the larger ones 1.2 mm. long. Areas of dorsal wax pores; head with large groups at anterior and posterior margin; prothorax with lateral areas, a row of 4 large anterior and 4 large posterior groups; mesothorax with a curved transverse row of six well defined groups, the outer ones forming the usual anterior-lateral groups, metathorax and abdominal segments I-VI with transverse rows of 6 groups each, VII-IX with only the marginal group. Fig. 125 was drawn from a pupa in its last stage but sometime before it molted. Later the conspicuous circular space about the gland openings is not so discernable.

The Migrant from the Spruce Gall. (Fig. 123). Length .9 mm.-1.3 mm.; wing expanse 3.5 mm.-4.0 mm. The wings of this species are very rotund. The veins in the fore wing are usually like those given in fig. 123 though frequently they are straighter. M in the hind wing usually curves with the concavity distad though sometimes this vein is nearly straight.

The most striking structural distinction between this and the other 5 spruce *Chermes* is in the antennae. The constrictions between joints III, IV, V are very inconspicuous so that these joints from some positions appear almost to be consolidated into a single long terminal joint. It was this character that suggested the specific name. The antennae of *consolidatus* are distinctive in one other respect, two of the four terminal hairs are developed into strong spines (Fig. 124a). This is not true of any of the other 5 spruce species.

Apterous oviparous form on larch.

On August 1, 1909, apterous oviparous forms in woolly mass on larch twigs were common. Although the connection was not traced I believe these to be *consolidatus* Fig. 126 was drawn from one of this collection.

CHERMES FLOCCUS Patch.

Like *Chermes pinifoliae* Fitch, this species develops in galls on black and red spruce and migrates to the needles of the white pine to oviposite. Both the galls and the insects, however, of these two species are too distinct to be in any respect confused.

These galls (fig. 134) were first collected on black spruce at Orono, July 10, 1909. They resemble galls of *similis* Gillette but are more compact and better formed than any galls of *similis* which were taken this season in Maine. They occurred in great numbers in this vicinity on red and black spruce. They are terminal and comprise the total deformed shoot. In length they vary from about $\frac{3}{4}$ to $1\frac{1}{4}$ inches. The surface of the gall is green in some while some have a dark purple tinge near the base of each needle, giving the gall a purple cast. The needles of the gall are not much dwarfed and are a normal spruce green. Figs. 135 and 136 give cross and longitudinal sections of this gall.

On account of the loose structure of the gall, syrphus maggots were very abundant within, feeding on the *Chermes* nymphs.

The pupa remains within the gall until after the last molt and the winged migrant emerges ready for flight.

Pupa. (Fig. 112). Described from specimen removed from gall shortly before the last molt. Length of body about 1.8 mm. Head, antennae, wing pads and legs dark or dusky, prothorax and abdomen rather dull reddish, thorax yellowish red and paler than abdomen. Entire body pulverulent. Wax gland areas on prothorax, thorax and abdomen are plainly located under a Zeiss binocular, by warty appearance of live specimen. These areas are: head with 2 large anterior and 2 larger posterior groups; prothorax with prominent lateral groups, also 2 small median anterior groups and 2 large posterior groups; mesothorax with prominent lateral areas, large median groups

and small anterior groups; metathorax with 2 median groups in line with these on head and pro- and meso-thorax and abdomen; abdomen with lateral groups on segments I-VIII, large median groups on segments I to VI and a row midway between the lateral and median groups on I to VI. None of the pore-groups are merged in the pupa.

Migrants from spruce gall to pine. (Fig. 110) 1.5 mm.-2.1 mm. long with wing expanse 5. 0-mm.-5.6 mm. Freshly molted individuals have a yellowish red body and pale buff wings. The antennae are characterized by the exceedingly large sensoria on joints III, IV, V. Each sensorium comprises the entire surface of the joint except the extreme proximal and distal portions and a narrow ridge connecting these. The constrictions between joints are abrupt. III and IV are subequal and V is longer and not so thick. The wings are rather narrow. 1st A in the fore wing curves, the convexity being distad. M of the hind wing curves, the concavity being distad. Large wax gland areas occur on head and the three thoracic segments. On the abdomen lateral groups are present on perfectly distinct darkened areas on segments I-VII, IV, V, and VI are transversely banded by wax pores across the dorsum. Merged median groups occur on I, II, III and on III a separate group (sometimes absent) midway between the median and lateral groups. I and II are without wax areas between the median and lateral groups.

These winged forms migrate, from the middle to the last of July near Orono, to pine needles where they oviposite .(Fig. 133.) The ovipositing females secrete considerable wax from head glands as well as over the rest of the body so that they are a decidedly flocculent and not pulverulent species. This character alone would distinguish them from *pinifoliae* and is chosen for the specific name on that account.

In the woods these migrants were found abundant on the white pine needles over egg clusters of about 40 eggs. Coming so much later in the season *floccus* finds both old and new growth pine needles available and deposits the egg mass indifferently on the old or new. *Pinifoliae* migrants occur in this region only on needles of previous years growth as they appear the middle of June.

Chermes floccus migrants are not so particular as *pinifoliae* as to which way they are headed, some migrants settling on

the pine needles with head toward the tip and some with head toward the base.

Besides the out-of-door observation of the migrants on white pine, a laboratory test was given. July 19 a lot of galls from which *floccus* were emerging were placed in a cage among the following conifers which were kept fresh in vials.

July 21 migrants had settled and deposited egg clusters as follows:

Picea mariana (Mill.) B. S. P.	Black spruce	0
Picea rubra Dietr.	Red spruce	0
Picea abies (L.) Karst.	Norway spruce	0
Picea canadensis (Mill.) B. S. P.	White spruce	5
Abies balsamea (L.) Mill.	Balsam fir	0
Tsuga canadensis Carr.	Hemlock	0
Pinus laricio Poir.var.*austriaca* Endl	Austrian pine	0
Pinus sylvestris	Scotch pine	0
Pinus strobus L.	White pine	92
Thuya occidentalis L.	Arbor vitae	0

July 21, two small tips of white pine alone were put with *floccus* galls. In 48 hours 57 *Chermes* had oviposited on one and 117 on the other. These eggs began to hatch July 28.

Chermes similis Gillette.

On July 9, 1909, my attention was called to some scraggly twigs of Norway spruce which proved to be deformed by *Chermes*. These galls resemble somewhat those of *floccus* but they are less regular. Fig. 142 pictures these. Winged specimens were emerging from these galls on date of collection. A search of white, red and black spruces resulted in taking the same galls on all these. These galls are very loose in structure and syrphus maggots freely helped themselves to their contents.

Galls from all these spruces contained pupae practically ready to molt and become the winged form, and also a few very small apterous oviparous individuals which were laying clusters of eggs in little woolly masses. These apterous forms were also found with their eggs in woolly masses along the stem and in one case on the outside of gall of *floccus* (fig. 134.) They were reddish brown and were .5 mm. to 1.0 mm. long.

The winged forms from the Norway spruce out of doors were migrating. On the other hand, the winged ones from

black spruce galls were settling and ovipositing freely on black spruce. They are a flocculent species and their wings showed dark against the woolly mass which covered their abdomens and egg clusters.

What the life-cycle relation of the apterous oviparous forms is to the migrants appearing and ovipositing at the same time I do not know. They are here considered as *similis* though their identity is not proven. The galls of *similis*, however, were the only ones discussed in this paper in which apterous oviparous forms were found. Professor Gillette also records apterous females and their egg clusters to be present in galls of *similis*.

A cage test as to preference of spruces of the migrants was made. July 9, galls from black spruce were caged with uninfested black, white and Norway spruces. By July 13 a few migrants had settled on the Norway and deposited but a decided preference was shown for the white spruce upon which they settled in plentiful numbers and deposited eggs, remaining for a time on the little white woolly masses.

July 9, galls from white spruce were placed with uninfested white, black and Norway spruces. A large majority chose the white spruce. The eggs of this species hatched in about a week.

On trees where the infestation was heavy the terminal shoots were sticky and the needles somewhat ruffled. (Fig. 144). In many places portions of the spruce needles turned whitish yellow giving a "blighted" appearance to the shoot.

The winged form (fig. 113), varied exceedingly in size, part of the emerging ones being about 1.0 mm. long with a wing expanse of 3.0 mm.-4.0 mm. while the majority were larger, ranging from 1.45 mm. to 1.7 mm. with a wing expanse of about 4.8 mm. Color of body reddish brown, wings a little smoky. Wings much as in *floccus* with the veins having a little more tendency to straightness. Antennae are more like those of *pinifoliae* than any other, both as to general shape of joints and the relative size of the sensoria. The wax gland areas are: head with dorsal surface nearly covered by the two anterior and posterior groups which nearly meet; prothorax with large lateral area, two anterior and two posterior groups; mesothorax with lateral anterior group and two very large median

groups; metathorax with median groups extending nearly across the segment; abdomen with large groups on I VI, median groups on I VI being largest on I and graduated to smallest on VI; a group of wax pores midway between the median and lateral series on segments II-VI, those on IV-VI being much larger than those on I II (the group on I, of 2 or 3 openings only, is sometimes missing).

Certain striking resemblances of this Maine collection to *similis* as described by Professor C. P. Gillette* led me to submit balsam mounts, galls and illustrations to him. On the basis of this data he stated that he is unable to find any good distinguishing characters to separate this Maine material from *similis*. Professor Gillette's courtesy in determining this species enables me to introduce *similis* from Maine.

Chermes pinicorticis Fitch.

It frequently happens that trunks of the white pine in Maine are more or less covered by the white secretion of this minute *Chermes* which gives the bark a moldy appearance (fig. 146). The infestation has been particularly heavy during 1908 and 1909, but during the latter season so many syrphus maggots were present preying upon the *Chermes* that these natural enemies seem likely to check its increase.

Though I have reared the winged forms of *pinicorticis*, I have made no special study of this species. Whether it confines itself to the pine or possesses an alternate host is not known. I have found the winged forms resting in abundance on needles of infested small white pines, from which they took flight at the slightest jar. Whether their destination was another species of plant or merely another white pine, the present knowledge of this species does not give basis to state.

Either the wing or the antennal characters of *Chermes pinicorticis* would serve to distinguish it from any of the 6 *Chermes* discussed in this paper, though its minute size alone would prevent confusion.

The fullest account of this species is by Mr. Storment published in the Appendix to the *Twentieth Report of the State Entomologist of Illinois*. In Mr. Storment's paper, as in others

* Chermes of Colorado Conifers. 1907.

on *pinicorticis* since Mr. Shimer by error merged *pinifoliae* with *pinicorticis* about 40 years ago*, the NAME *pinifoliae* is confused with *pinicorticis* both in the discussion and bibliography. It is evident from the context, however, that neither Mr. Shimer, Professor Osborn or Mr. Storment had observed the INSECT *pinifoliae* and for this reason the mistake in synonymy is very easily corrected.

CONCLUSION.

The present paper deals with six gall forming *Chermes* of Maine conifers. The gall host and the alternate host, where there is one, has been in each case ascertained. No attempt has been made to follow the development of the winter generation. With three species of *Chermes* making galls on the white spruce and four on black spruce in one locality it is apparent that a detailed study of the winter generations could only be carried on satisfactorily on conifers raised from seed under quarantine.

A glance at fig. 134 where *Chermes similis* is seen ovipositing on galls of *Chermes floccus* is sufficient to suggest the confusion possible.

Both the galls and the winged individuals give characters sufficient to determine these six species, however, and these have been figured in each case.

Illustrations. The photographs published are selected from many taken by Mr. R. L. Hammond and have been a constant aid in recording permanently certain changing phases of the work of these *Chermes*, and have been a necessary part of the study. The drawings were made by Miss Charlotte M. King who spent most of the summer of 1909 at the Maine Agricultural Experiment Station. The structural details for each form figured were worked out independently by Miss King. During the same time the writer studied carefully with each species the arrangement and number of wax gland areas, the character of the antennal sensoria, wing characters and other significant points and the drawings as they stand record both Miss King's observations and my own critical interpretation, no detail that seemed important being left until sufficient material was examined for a mutual agreement.

---

* For discussion see pp. 277-289 in this present paper.

Technique. At the time these species were studied, live material was available both for the pupae and winged forms. The general form of the individual was sketched first from live material and such structures as could then be ascertained were indicated. Details were studied and drawings completed from balsam mounts. Live specimens in some cases were mounted directly in the balsam and a few desirable results obtained for immediate use. In each case, however, a large series of mounts was carefully made for study, drawings, and photomicrographs. Total mounts were most satisfactory after the general method (modified according to size, readiness of penetration of the fluids, etc.) indicated as follows:

Killed in hot 98 per cent alcohol,
One hour in 80 per cent alcohol,
One-half hour in 98 per cent alcohol,
Ten minutes in 100 per cent alcohol,
Ten minutes in tolu.

Antennal details were taken from head mounts. Wings were in each species mounted separately. Where total mounts did not bring out clearly the wax gland areas of both thorax and abdomen, severed specimens were prepared to facilitate the more rapid and thorough clearing.

This detailed account of the method of preparation is given in order that the character of the material used may be recorded. Certain groups of wax pores, for instance, were not rendered visible in one or two species except in dissected specimens and in most, a large series was necessary to settle the number definitely. Some variation occurs in the size and arrangement of the groups of wax pores, but individuals figured and described represent the typical wax pore areas as they were seen. As the wax pores are often difficult to see the most convenient specific characters will be found in the wing and antennal characters which are distinctive and within slightly varying limits were constant, for the extended collection in this locality at least.

Wing Vein Nomenclature.

For the nomenclature of the wing veins used here the reader is referred to *Homologies of the Wing Veins of the Aphididae, Psyllidae, Aleurodidae, and Coccidae, Annals of the Entomological Society of America,* June 1909.

New Species.

It is possible that some of the species described as new may prove to be synonyms of European species, but as the inconvenience of a synonymy is so much less than the confusion of a composite species it seemed wise not to attempt comparison with European species until a careful study had been made of these *Chermes* as they occur in Maine.

The first brief descriptions of *floccus, consolidatus*, and *lariciatus* were published in Psyche, December, 1909.

Chermes in Europe.

Many important and admirable studies of *Chermes* species have been carried on in Europe by such careful workers as Blochmann, Borner, Cholodkovsky, Dampf, Dreyfus, Mordwilko, Nüsslin. A comprehensive review of this work with bibliography appeared in *Zoologisches Zentralblatt*, Dec., 1909. *Zusammenfassende Übersicht. Die neueren Ergebnisse und Aufgaben der Chermes-Forschung von Prof. O. Nüsslin in Karlsruhe.*

Host Plants.

The host plants in the following key are recorded solely on the basis of one season's careful collection in the vicinity of Orono. The list of host plants may need to be extended later but it is accurate so far as it goes. In recording the collections of the galls, the botanical distinctions between the red and black spruces has been observed, though entomologically these might pass for one species. *Chermes* at any rate does not pay any attention to the distinction.

Key to the Chermes of Maine Conifers.

A. Galls on black spruce (*Picea mariana* B. S. P.) and red spruce (*Picea rubra* Dietr.)

Gall terminal.

1. Gall conelike, needles modified to thin scales. Ripening mid-June. Migrants ovipositing on needles of white pine. (*Pinus strobus* L.)

pinifoliae.

2. Scraggly deformed twig. Gall-needles not much abbreviated. Ripening first of July. Migrants ovipositing on spruce *Picea* sp. *similis.*
3. Gall usually well formed ¾-1¼ in. long. Needles not much abbreviated. Ripening mid-July. Migrants ovipositing on needles of white pine. (*Pinus strobus* L.) *floccus.*
4. Gall small, ½ inch or less, pink or pale green. Gall needles short. Ripening first of August. Species also found on larch (*Larix laricina* Koch.) *consolidatus.*

B. Galls on white spruce.

Gall terminal,

Scraggly deformed branch. Ripening first of July. Migrants ovipositing on spruce (*Picea* sp.) *similis.*

Gall not terminal,

1. Pine-apple shaped. Ripening last of July. Migrants ovipositing on needles of larch. (*Larix laricina* Koch.) *lariciatus.*
2. Pine-apple shaped. Ripening mid-August. Winged form not migrating to oviposite. *abietis.*

C. Galls on Norway spruce, *Picea abies* (L.) Karst.

Gall terminal,

Scraggly deformed branch. Ripening first of July. Migrants ovipositing on spruce, *Picea* sp. *similis.*

Gall not terminal,

Pine-apple shaped. Ripening mid-August. Winged form not migrating to oviposite. *abietis.*

Explanation of Plates.

Fig. 108. *Chermes pinifoliae* Fitch. Migrant from spruce gall to needles of white pine. Figs. 109, 109a. Antenna.

Fig. 110. *Chermes floccus* Patch. Migrant from spruce gall to needles of white pine. Figs. 111, 111a. Antenna.

Fig. 112. *Chermes floccus,* pupa developing in spruce gall.

Fig. 113. *Chermes similis* Gillette. Form which emerges from spruce gall. Figs. 114, 114a. Antenna.

Fig. 115. *Chermes abictis.* Form which emerges from spruce gall. Fig. 116. Antenna.

Fig. 117. *Chermes abictis,* pupa developing in spruce gall.

Fig. 118. *Chermes lariciatus* Patch. Migrant from spruce gall to needles of larch. Figs. 119, 119a. Antenna.

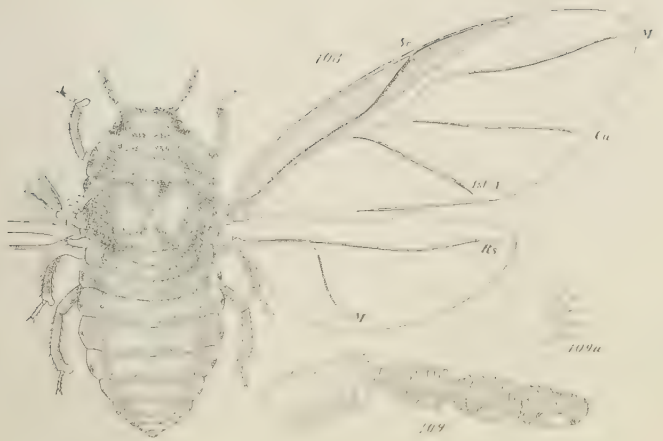
Fig. 120. *Chermes lariciatus.* Migrant on needle of larch with egg mass nearly completed and showing through the thin transparent wings. Drawn from living specimen.

Fig. 121. *Chermes lariciatus.* Egg mass on larch needle.

Fig. 122. *Chermes lariciatus.* Pupa developing in spruce gall.

Fig. 123. *Chermes consolidatus* Patch. Migrant which develops in spruce gall. Figs. 124, 124a. Antenna. Notice two strong terminal spines.

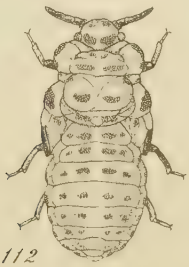
Fig. 125. *Chermes consolidatus,* pupa developing in spruce gall.
Fig. 126. *Chermes consolidatus?* Apterous oviparous form on larch.
Fig. 127. *Chermes pinifoliae* Fitch. Migrants from spruce to white pine needles.
Fig. 128. *Chermes pinifoliae.* Mature galls from black spruce still green and just before opening.
Fig. 129. Branch of black spruce. *A* cone with tip broken, *B* four normal spruce tips, *C* four young galls of *pinifoliae.*
Fig. 130. Tip of black spruce. *A* cone which is purple, *B* normal tip, *C* deserted *pinifoliae* gall which is bright reddish brown.
Fig. 131. Deserted galls of *Chermes pinifoliae* on red spruce.
Fig. 132. White pine showing injury to new growth by the young *pinifoliae* which may be located by the white secretion on twig at base of new growth. Photographed July 23, 1909.
Fig. 133. *Chermes floccus* Patch, migrants from spruce galls, ovipositing on white pine needles.
Fig. 134. Galls of *Chermes floccus* on red spruce. The white objects on the outside of the gall are waxy secretions of *Chermes similis,* apterous forms, which are ovipositing on *floccus* galls as well as on the twig.
Fig. 135. Gall of *Chermes floccus* from black spruce. Cross section. Fig. 136. Longitudinal section.
Fig. 137. Twig of white spruce with galls of *Chermes abietis.*
Fig. 138. Galls of *Chermes abietis* from Norway spruce. Longitudinal section of gall which does not enclose the whole twig. Fig. 139. Longitudinal section of gall which completely encircles the twig.
Fig. 140. Twig of Norway spruce. Show deserted gall of *Chermes abietis* and the white molted skins along twig and leaves.
Fig. 141. Twig of white spruce with galls of *Chermes lariciatus* Patch. Gall at right deserted. Gall at left not yet opened.
Fig. 142. Galls of *Chermes similis* Gillette on Norway spruce.
Fig. 143. Apterous flocculent oviparous females of *Chermes similis* showing white on stem of Norway spruce.
Fig. 144. Twig of black spruce showing injury to young of *Chermes similis.* Needles sickly yellow and covered with white flocculent secretion of the *Chermes.*
Fig. 145. Gall of *Chermes consolidatus* Patch on black spruce.
Fig. 146. *Chermes pinicorticis* Fitch on bark of white pine.


M
Cu
Rs
M
109a
109

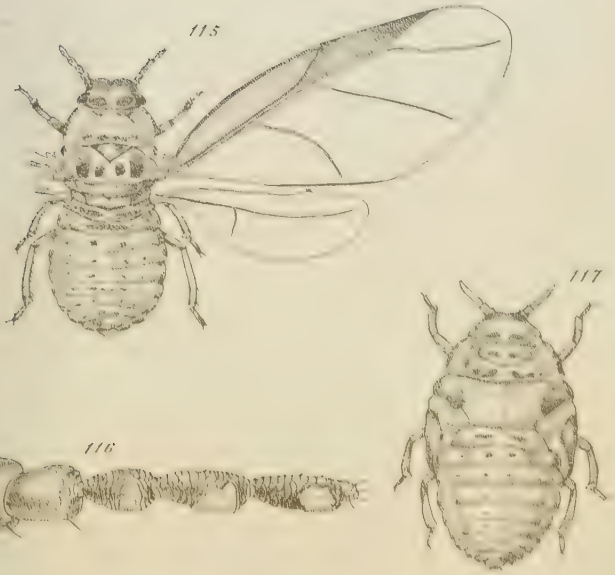
110

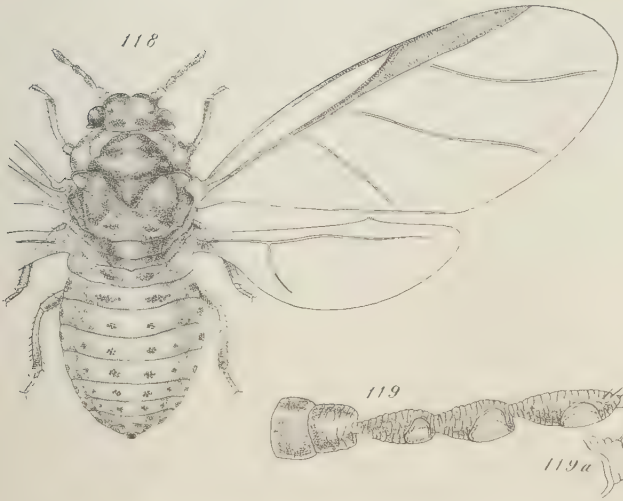
111

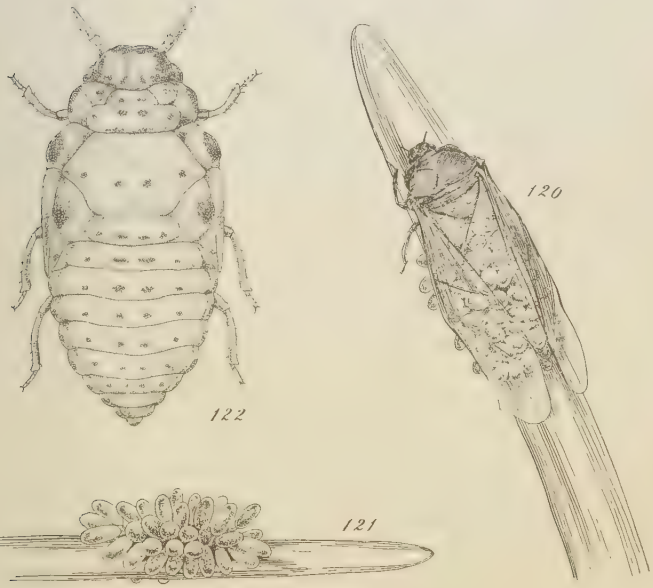
111a


112

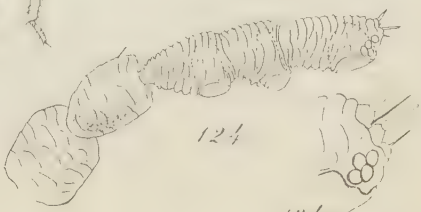
113
114
114a


115
116
117


118
119
119a


120
121
122

123


124

124 a

125

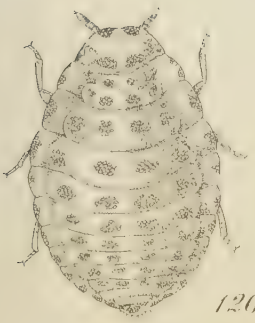

126

Fig. 127

Fig. 128

Chermes pinifoliae Fitch. Fig. 127, Migrants on white pine. Fig. 128, Galls on black spruce.

Fig. 129

Fig. 131

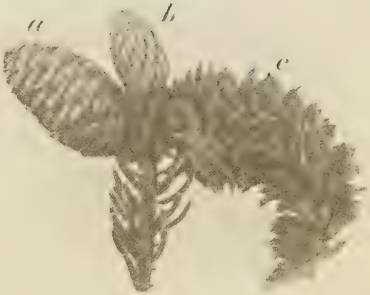


Fig. 130

Chermes pinifoliae Fitch. Galls on spruce.

Fig. 132

Chermes pinifoliae Fitch. Young in white secretion towards tips of twigs of white pine

Fig. 133

Fig. 135

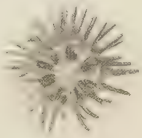


Fig. 136

Fig. 134

Chermes floccus Patch. Migrants on white pine and galls on spruce

Fig. 137. *Chermes abietis* Linn. Galls on white spruce

Fig. 138

Fig. 139

Fig. 140

Chermes abietis Linn. Galls on Norway spruce

Fig. 141. *Chermes laricıatus* Patch. Galls on white spruce

Fig. 142. *Chermes similis* Gillette. Galls on Norway spruce

Fig. 143

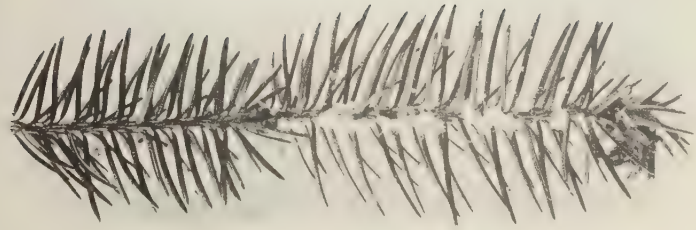


Fig. 144

Chermes similis Gillette

Fig. 145

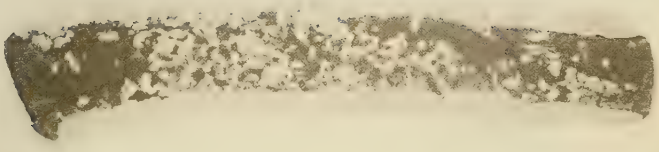


Fig 146

Fig. 145. *Chermes consolidatus* Patch. Gall on black spruce
Fig. 146. *Chermes pinicorticis* Fitch. On bark of white pine.

MAINE STATE COLLEGE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 35. MAY, 1897.

THE CURRANT FLY.

EPOCHRA CANADENSIS, LOEW.

Requests for the Bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

Maine State College

Agricultural Experiment Station.

THE STATION COUNCIL.

President Abram W. Harris	*President*
Director Charles D. Woods	*Secretary*
Benjamin F. Briggs, Auburn	*Committee of Board of Trustees.*
Arthur L. Moore, Orono	
Elliott Wood, Winthrop	
B. Walker McKeen, Fryeburg	*State Board of Agriculture*
Ora O. Crosby, Albion	*State Grange*
Charles S. Pope, Manchester	*State Pomological Society*
James M. Bartlett	*Members of the Station Staff.*
Lucius H. Merrill	
Francis L. Harvey	
Fremont L. Russell	
Welton M. Munson	
Gilbert M. Gowell	

THE STATION STAFF.

The President of the College.	
Charles D. Woods	*Director*
James M. Bartlett	*Chemist*
Lucius H. Merrill	*Chemist*
Francis L. Harvey	*Botanist and Entomologist*
Fremont L. Russell	*Veterinarian*
Welton M. Munson	*Horticulturist*
Gilbert M. Gowell	*Agriculturist*
Henry B. Slade	*Assistant Chemist*
Ora W. Knight,	*Assistant Chemist*
Lucius J. Shepard	*Assistant Horticulturist*
Mrs. J. Hamlin Waite	*Stenographer*

Maine Agricultural Experiment Station

BULLETIN No. 56. DECEMBER, 1899.

APPLE INSECTS OF MAINE.

This Bulletin gives a description of the more common insect pests of the apple, together with their habits, vulnerable points, and remedies.

Requests for the Bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE

AGRICULTURAL EXPERIMENT STATION

ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT ABRAM W. HARRIS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
ARTHUR L. MOORE, Camden	*Committee of Board of Trustees*
EDWARD B. WINSLOW, Portland	*Committee of Board of Trustees*
VORANUS C. COFFIN, Harrington	*Committee of Board of Trustees*
B. WALKER MCKEEN, Fryeburg	*State Board of Agriculture*
OTIS MEADER, Albion	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
JAMES M. BARTLETT	*Members of the Station Staff.*
LUCIUS H. MERRILL	*Members of the Station Staff.*
FRANCIS L. HARVEY	*Members of the Station Staff.*
FREMONT L. RUSSELL	*Members of the Station Staff.*
WELTON M. MUNSON	*Members of the Station Staff.*
GILBERT M. GOWELL	*Members of the Station Staff.*

THE STATION STAFF.

THE PRESIDENT OF THE UNIVERSITY.

CHARLES D. WOODS	*Director*
JAMES M. BARTLETT	*Chemist*
LUCIUS H. MERRILL	*Chemist*
FRANCIS L. HARVEY	*Botanist and Entomologist*
FREMONT L. RUSSELL	*Veterinarian*
WELTON M. MUNSON	*Horticulturist*
GILBERT M. GOWELL	*Agriculturist*
LUCIUS J. SHEPARD	*Assistant Horticulturist*
ORA W. KNIGHT	*Assistant Chemist*
ANDREW J. PATTEN	*Assistant Chemist*
EDWARD R. MANSFIELD	*Assistant Chemist*

Maine Agricultural Experiment Station

BULLETIN No. 61. MARCH, 1900.

NOTES ON INSECTS AND PLANTS.

This Bulletin contains notes on the specimens of insects and plants sent to the Station by correspondents in 1899. It also contains a full account of the brown tail moth, a new pest to fruit trees and shrubs which is reported as established in Kittery.

Requests for the Bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE

AGRICULTURAL EXPERIMENT STATION

ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT ABRAM W. HARRIS.....*President*
DIRECTOR CHARLES D. WOODS.....*Secretary*
ARTHUR L. MOORE, Camden.....
EDWARD B. WINSLOW, Portland..... } *Committee of Board of Trustees*
VORANUS C. COFFIN, Harrington.....
B. WALKER MCKEEN, Fryeburg.....*State Board of Agriculture*
EUGENE HARVEY LIBBEY, Auburn.....*State Grange*
CHARLES S. POPE, Manchester.....*State Pomological Society*
JAMES M. BARTLETT.....
LUCIUS H. MERRILL.....
FRANCIS L. HARVEY..... } *Members of the Station Staff*
FREMONT L. RUSSELL.....
WELTON M. MUNSON.....
GILBERT M. GOWELL.....

THE STATION STAFF.

THE PRESIDENT OF THE UNIVERSITY.

CHARLES D. WOODS.....*Director*
JAMES M. BARTLETT.....*Chemist*
LUCIUS H. MERRILL.....*Chemist*
FRANCIS L. HARVEY.....*Botanist and Entomologist*
FREMONT L. RUSSELL.....*Veterinarian*
WELTON M. MUNSON.....*Horticulturist*
GILBERT M. GOWELL.....*Stock Breeding and Poultry*
LUCIUS J. SHEPARD.....*Assistant in Agriculture*
ORA W. KNIGHT.....*Assistant Chemist*
ANDREW J. PATTEN.....*Assistant Chemist*
EDWARD R. MANSFIELD.....*Assistant Chemist*

Maine Agricultural Experiment Station

BULLETIN No. 83. JUNE, 1902.

THE GRASS THRIPS.

This Bulletin contains a study on the anatomy, histology, development and habits of the grass thrips, (Anaphothrips striata, Osborn.)

Requests for the Bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE

AGRICULTURAL EXPERIMENT STATION.

ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
EDWARD B. WINSLOW, Portland	*Committee of Board of Trustees*
VORANUS C. COFFIN, Harrington	*Committee of Board of Trustees*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE HARVEY LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
JAMES M. BARTLETT	*Members of the Station Staff*
LUCIUS H. MERRILL	*Members of the Station Staff*
FREMONT L. RUSSELL	*Members of the Station Staff*
WELTON M. MUNSON	*Members of the Station Staff*
GILBERT M. GOWELL	*Members of the Station Staff*
GILMAN A. DREW	*Members of the Station Staff*

THE STATION STAFF.

THE PRESIDENT OF THE UNIVERSITY.

CHARLES D. WOODS	*Director*
JAMES M. BARTLETT	*Chemist*
LUCIUS H. MERRILL	*Chemist*
FREMONT L. RUSSELL	*Veterinarian*
WELTON M. MUNSON	*Horticulturist*
GILBERT M. GOWELL	*Stock Breeding and Poultry*
GILMAN A. DREW	*Zoologist*
EDWARD R. MANSFIELD	*Assistant Chemist*
HERMAN H. HANSON	*Assistant Chemist*
HERBERT W. BRITCHER	*Assistant Zoologist*
MARSHALL P. CUMMINGS	*Assistant in Horticulture*

Maine Agricultural Experiment Station

BULLETIN No. 91. APRIL, 1903.

THE CHINCH BUG IN MAINE.

This bulletin contains an account of the Chinch Bug in Maine, together with a description of the insect, its habits and enemies, and methods by which it may be successfully fought.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE

AGRICULTURAL EXPERIMENT STATION,

ORONO, MAINE.

THE STATION COUNCIL.

President George E. Fellows	*President*
Director Charles D. Woods	*Secretary*
Edward B. Winslow, Portland	*Committee of Board of Trustees*
Voranus C. Coffin, Harrington	*Committee of Board of Trustees*
John A. Roberts, Norway	*Committee of Board of Trustees*
Augustus W. Gilman, Foxcroft	*Commissioner of Agriculture*
Eugene Harvey Libby, Auburn	*State Grange*
Charles S. Pope, Manchester	*State Pomological Society*
Rutillus Alden, Winthrop	*State Dairymen's Association*
James M. Bartlett	*Members of the Station Staff*
Lucius H. Merrill	*Members of the Station Staff*
Fremont L. Russell	*Members of the Station Staff*
Welton M. Munson	*Members of the Station Staff*
Gilbert M. Gowell	*Members of the Station Staff*
Gilman A. Drew	*Members of the Station Staff*

THE STATION STAFF.

The President of the University.

Charles D. Woods	*Director*
James M. Bartlett	*Chemist*
Lucius H. Merrill	*Chemist*
Fremont L. Russell	*Veterinarian*
Welton M. Munson	*Horticulturist*
Gilbert M. Gowell	*Stock Breeding and Poultry*
Gilman A. Drew	*Zoologist*
Edward R. Mansfield	*Assistant Chemist*
Herman H. Hanson	*Assistant Chemist*
Horace W. Britcher	*Assistant Zoologist*
Marshall B. Cummings	*Assistant in Horticulture*

Maine Agricultural Experiment Station

BULLETIN No. 96. OCTOBER, 1903.

PLANT-HOUSE ALEYRODES.

This Bulletin contains a study on the anatomy, histology, development and habits of the plant-house Aleyrodes (Aleyrodes vaporariorum) Westw. and suggested remedies for the pest.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	
CHARLES L. JONES, Corinna	*Committee of Board of Trustees*
ALBERT J. DURGIN, Orono	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE HARVEY LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILUS ALDEN, Winthrop	*State Dairymen's Association*
JAMES M. BARTLETT	*Members of the Station Staff*
LUCIUS H. MERRILL	*Members of the Station Staff*
FREMONT L. RUSSELL	*Members of the Station Staff*
WELTON M. MUNSON	*Members of the Station Staff*
GILBERT M. GOWELL	*Members of the Station Staff*

THE STATION STAFF.

THE PRESIDENT OF THE UNIVERSITY.

CHARLES D. WOODS	*Director*
JAMES M. BARTLETT	*Chemist*
LUCIUS H. MERRILL	*Chemist*
FREMONT L. RUSSELL	*Veterinarian*
WELTON M. MUNSON	*Horticulturist*
GILBERT M. GOWELL	*Stock Breeding and Poultry*
MARSHALL P. CUMMINGS	*Entomologist*
HERMAN H. HANSON	*Assistant in Horticulture*
SANFORD C. DINSMORE	*Assistant Chemist*
	Assistant Chemist

Maine Agricultural Experiment Station

BULLETIN No. 108 NOVEMBER, 1904.

BROWN-TAIL MOTH AND OTHER ORCHARD MOTHS.

This bulletin contains an account of the brown-tail moth, and notes upon a few common orchard caterpillars together with some insect eating birds.

Requests for the Bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE
AGRICULTURAL EXPERIMENT STATION,
ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
CHARLES L. JONES, Corinna	*Committee of Board of Trustees*
ALBERT J. DURGIN, Orono	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*
JAMES M. BARTLETT	*Members of the Station Staff*
LUCIUS H. MERRILL	*Members of the Station Staff*
FREMONT L. RUSSELL	*Members of the Station Staff*
WELTON M. MUNSON	*Members of the Station Staff*
GILBERT M. GOWELL	*Members of the Station Staff*

THE STATION STAFF.

THE PRESIDENT OF THE UNIVERSITY.

CHARLES D. WOODS	*Director*
JAMES M. BARTLETT	*Chemist*
LUCIUS H. MERRILL	*Chemist*
FREMONT L. RUSSELL	*Veterinarian*
WELTON M. MUNSON	*Horticulturist*
GILBERT M. GOWELL	*Stock Breeding and Poultry*
EDITH M. PATCH	*Entomologist*
HERMAN H. HANSON	*Assistant Chemist*
SANFORD C. DINSMORE	*Assistant Chemist*

IMP. BUREAU, ENTOM
REC.D 19 APR. 1913
ANS.D

Maine Agricultural Experiment Station

BULLETIN No. 109. DECEMBER, 1904.

APPLE MAGGOT AND OTHER INSECTS.

This bulletin contains notes upon the Apple Maggot with preventive and remedial measures; and the insects sent to the Station for identification in 1904.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE
AGRICULTURAL EXPERIMENT STATION,
ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	
CHARLES L. JONES, Corinna	*Committee of Board of Trustees*
ALBERT J. DURGIN, Orono	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*
JAMES M. BARTLETT	*Members of the Station Staff*
LUCIUS H. MERRILL	*Members of the Station Staff*
FREMONT L. RUSSELL	*Members of the Station Staff*
WELTON M. MUNSON	*Members of the Station Staff*
GILBERT M. GOWELL	*Members of the Station Staff*

THE STATION STAFF.

THE PRESIDENT OF THE UNIVERSITY.

CHARLES D. WOODS	*Director*
JAMES M. BARTLETT	*Chemist*
LUCIUS H. MERRILL	*Chemist*
FREMONT L. RUSSELL	*Veterinarian*
WELTON M. MUNSON	*Horticulturist*
GILBERT M. GOWELL	*Stock Breeding and Poultry*
EDITH M. PATCH	*Entomologist*
HERMAN H. HANSON	*Assistant Chemist*
SANFORD C. DINSMORE	*Assistant Chemist*

IMP. BUREAU. ENTOM.
RECD 19 APR. 1913
ANSD

Maine Agricultural Experiment Station

BULLETIN No. 121. DECEMBER, 1905.

THE COTTONY GRASS SCALE.

This bulletin contains a description of the cottony grass scale, together with its life history, natural enemies, remedial measures and bibliography.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL.

President George E. Fellows	*President*
Director Charles D. Woods	*Secretary*
John A. Roberts, Norway	*Committee of Board of Trustees*
Charles L. Jones, Corinna	
Albert J. Durgin, Orono	
Augustus W. Gilman, Foxcroft	*Commissioner of Agriculture*
Eugene H. Libby, Auburn	*State Grange*
Charles S. Pope, Manchester	*State Pomological Society*
Rutillus Alden, Winthrop	*State Dairymen's Association*
James M. Bartlett	*Members of the Station Staff*
Lucius H. Merrill	
Fremont L. Russell	
Welton M. Munson	
Gilbert M. Gowell	
Edith M. Patch	

THE STATION STAFF.

Charles D. Woods	*Director*
James M. Bartlett	*Chemists*
Lucius H. Merrill	
Herman H. Hanson	
Lewis I. Nurenberg	
Fremont L. Russell	*Veterinarian*
Welton M. Munson	*Horticulturist*
Gilbert M. Gowell	*Poultry Investigations*
Walter Anderson	
Edith M. Patch	*Entomologist*
Bessie G. Leeds	*Microscopist and Photographer*
Annie M. Snow	*Clerk and Stenographer*
Henry A. Millett	*Meteorological Observer and Janitor*

IMP. BUREAU ENTOM.
REC'D 19 APR. 1913
ANS'D

Maine Agricultural Experiment Station

BULLETIN No. 123. DECEMBER, 1905.

STRAWBERRY CROWN GIRDLER.

This bulletin contains notes upon the strawberry crown girdler with preventive and remedial measures; and insect notes for 1905.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
CHARLES L. JONES, Corinna	*Committee of Board of Trustees*
ALBERT J. DURGIN, Orono	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*
JAMES M. BARTLETT	*Members of the Station Staff*
LUCIUS H. MERRILL	*Members of the Station Staff*
FREMONT L. RUSSELL	*Members of the Station Staff*
WELTON M. MUNSON	*Members of the Station Staff*
GILBERT M. GOWELL	*Members of the Station Staff*
EDITH M. PATCH	*Members of the Station Staff*

THE STATION STAFF.

CHARLES D. WOODS	*Director*
JAMES M. BARTLETT	*Chemists*
LUCIUS H. MERRILL	*Chemists*
HERMAN H. HANSON	*Chemists*
LEWIS I. NURENBERG	*Chemists*
FREMONT L. RUSSELL	*Veterinarian*
WELTON M. MUNSON	*Horticulturist*
GILBERT M. GOWELL	*Poultry Investigations*
WALTER ANDERSON	*Poultry Investigations*
EDITH M. PATCH	*Entomologist*
BESSIE G. LEEDS	*Microscopist and Photographer*
ANNIE M. SNOW	*Clerk and Stenographer*
HENRY A. MILLETT	*Meteorological Observer and Janitor*

IMP. BUREAU, ENTOM
REC'D 19 APR. 1913
ANS'D

Maine Agricultural Experiment Station

BULLETIN No. 134. DECEMBER, 1906.

INSECT NOTES FOR 1906.

This bulletin contains notes upon the brown-tail moth; Aroostook potato insects; alder blight and attendant insects; the larch case bearer; and brief notes upon the other chief insects of the year.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL.

President George E. Fellows	*President*
Director Charles D. Woods	*Secretary*
John A. Roberts, Norway	*Committee of Board of Trustees*
Charles L. Jones, Corinna	*Committee of Board of Trustees*
Albert J. Durgin, Orono	*Committee of Board of Trustees*
Augustus W. Gilman, Foxcroft	*Commissioner of Agriculture*
Eugene H. Libby, Auburn	*State Grange*
Charles S. Pope, Manchester	*State Pomological Society*
Rutillus Alden, Winthrop	*State Dairymen's Association*
James M. Bartlett	*Members of the Station Staff*
Lucius H. Merrill	*Members of the Station Staff*
Fremont L. Russell	*Members of the Station Staff*
Welton M. Munson	*Members of the Station Staff*
Gilbert M. Gowell	*Members of the Station Staff*
Edith M. Patch	*Members of the Station Staff*
Warner J. Morse	*Members of the Station Staff*

THE STATION STAFF.

Charles D. Woods	*Director*
James M. Bartlett	*Chemists*
Lucius H. Merrill	*Chemists*
Herman H. Hanson	*Chemists*
Arthur C. Whittier	*Chemists*
Joanna C. Colcord	*Chemists*
Fremont L. Russell	*Veterinarian*
Welton M. Munson	*Pomologist*
Gilbert M. Gowell	*Poultry Investigations*
Walter Anderson	*Poultry Investigations*
Edith M. Patch	*Entomologist*
Warner J. Morse	*Vegetable Pathologist*
Royden L. Hammond	*Seed Analyst and Photographer*
Annie M. Snow	*Clerk and Stenographer to the Director*
Blanche F. Pooler	*Stenographer*
Henry A. Millett	*Meteorological Observer and Janitor*

IMP. BUREAU. ENTOM.
REC'D 19 APR. 1915
ANS'D

Maine Agricultural Experiment Station

BULLETIN No. 147. NOVEMBER, 1907.

THE POTATO PLANT LOUSE.

This bulletin contains an account of the potato plant louse which has infested Maine potato fields the past few years.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE

AGRICULTURAL EXPERIMENT STATION

ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
CHARLES L. JONES, Corinna	*Committee of Board of Trustees*
SAMUEL W. GOULD, Skowhegan	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*
JAMES M. BARTLETT	*Members of the Station Staff*
LUCIUS H. MERRILL	*Members of the Station Staff*
FREMONT L. RUSSELL	*Members of the Station Staff*
GILBERT M. GOWELL	*Members of the Station Staff*
EDITH M. PATCH	*Members of the Station Staff*
WARNER J. MORSE	*Members of the Station Staff*
RAYMOND PEARL	*Members of the Station Staff*

THE STATION STAFF.

CHARLES D. WOODS	*Director*
JAMES M. BARTLETT	*Chemists*
LUCIUS H. MERRILL	*Chemists*
HERMAN H. HANSON	*Chemists*
ARTHUR C. WHITTIER	*Chemists*
JOANNA C. COLCORD	*Chemists*
FREMONT L. RUSSELL	*Veterinarian*
GILBERT M. GOWELL	*Poultry Investigations*
WALTER ANDERSON	*Poultry Investigations*
EDITH M. PATCH	*Entomologist*
WARNER J. MORSE	*Vegetable Pathologist*
RAYMOND PEARL	*Biologists*
FRANK M. SURFACE	*Biologists*
REX C. GELLERSON	*Inspector*
ROYDEN L. HAMMOND	*Seed Analyst and Photographer*
ANNIE M. SNOW	*Clerk and Stenographer to the Director*
BLANCHE F. POOLER	*Stenographer*
HENRY A. MILLETT	*Meteorological Observer and Janitor*
FRANK D. STERRY	*Laboratory Assistant*

IMP. BUREAU. ENTOM
REC'D 19 APR. 1913
ANS'D

Maine Agricultural Experiment Station

BULLETIN No. 148. NOVEMBER, 1907.

INSECT NOTES FOR 1907.

This bulletin contains notes upon orchard insects; grass hoppers; beetles; a forest attack by one of "The Prominents"; Aroostook potato insects; and brief notes upon the other chief insects of the year.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
CHARLES L. JONES, Corinna	
SAMUEL W. GOULD, Skowhegan	
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*
JAMES M. BARTLETT	*Members of the Station Staff*
LUCIUS H. MERRILL	
FREMONT L. RUSSELL	
GILBERT M. GOWELL	
EDITH M. PATCH	
WARNER J. MORSE	
RAYMOND PEARL	

THE STATION STAFF.

CHARLES D. WOODS	*Director*
JAMES M. BARTLETT	*Chemists*
LUCIUS H. MERRILL	
HERMAN H. HANSON	
ARTHUR C. WHITTIER	
JOANNA C. COLCORD	
FREMONT L. RUSSELL	*Veterinarian*
GILBERT M. GOWELL	*Poultry Investigations*
WALTER ANDERSON	
EDITH M. PATCH	*Entomologist*
WARNER J. MORSE	*Vegetable Pathologist*
RAYMOND PEARL	*Biologists*
FRANK M. SURFACE	
REX C. GELLERSON	*Inspector*
ROYDEN L. HAMMOND	*Seed Analyst and Photographer*
ANNIE M. SNOW	*Clerk and Stenographer to the Director*
BLANCHE F. POOLER	*Stenographer*
HENRY A. MILLETT	*Meteorological Observer and Janitor*
FRANK D. STERRY	*Laboratory Assistant*

IMP. BUREAU, ENTOM
RECD 19 APR. 1913
ANSR

University of Maine

Maine Agricultural Experiment Station

ORONO

BULLETIN No. 161 NOVEMBER, 1908

THE SADDLED PROMINENT.

CONTENTS.

	PAGE
Discussion of name	313
Description	316
Seasonal history	323
Habits	328
Natural enemies	340
Combatative measures	349

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
CHARLES L. JONES, Corinna	*Committee of Board of Trustees*
SAMUEL W. GOULD, Skowhegan	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*
JAMES M. BARTLETT	*Members of the Station Staff*
FREMONT L. RUSSELL	*Members of the Station Staff*
EDITH M. PATCH	*Members of the Station Staff*
WARNER J. MORSE	*Members of the Station Staff*
RAYMOND PEARL	*Members of the Station Staff*
HERMAN H. HANSON	*Members of the Station Staff*
FRANK M. SURFACE	*Members of the Station Staff*
CHARLES E. LEWIS	*Members of the Station Staff*

THE STATION STAFF.

CHARLES D. WOODS		*Director*
BIOLOGY	RAYMOND PEARL	*Biologist*
	FRANK M. SURFACE	*Associate*
	FREMONT L. RUSSELL	*Assistant*
	MAYNIE R. CURTIS	*Assistant*
	WALTER ANDERSON	*Poultryman*
	LOTTIE E. McPHETERS	*Computer*
CHEMISTRY	JAMES M. BARTLETT	*Chemist*
	HERMAN H. HANSON	*Associate*
	JOANNA C. COLCORD	*Assistant*
	JOSEPH F. MERRILL	*Assistant*
ENTOMOLOGY	REX C. GELLERSON	*Inspector*
	EDITH M. PATCH	*Entomologist*
	ALICE W. AVERILL	*Laboratory Assistant*
PLANT PATHOLOGY	WARNER J. MORSE	*Pathologist*
	CHARLES E. LEWIS	*Associate*
	FRANK D. STERRY	*Laboratory Assistant*
ROYDON L. HAMMOND		*Seed Analyst and Photographer*
ANNIE M. SNOW		*Clerk and Stenographer to the Director*
BLANCHE F. POOLER		*Stenographer*
HENRY A. MILLETT		*Meteorological Observer and Janitor*

IMP. BUREAU, ENTOM.
REC'D 19 APR 1915
ANS'D.

University of Maine

Maine Agricultural Experiment Station

ORONO

BULLETIN No. 162 DECEMBER, 1908

INSECT NOTES.

This bulletin contains brief accounts of the more important insects of the year 1908.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
CHARLES L. JONES, Corinna	
SAMUEL W. GOULD, Skowhegan	
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*
JAMES M. BARTLETT	*Members of the Station Staff*
FREMONT L. RUSSELL	
EDITH M. PATCH	
WARNER J. MORSE	
RAYMOND PEARL	
HERMAN H. HANSON	
FRANK M. SURFACE	
CHARLES E. LEWIS	

THE STATION STAFF.

CHARLES D. WOODS		*Director*
BIOLOGY	RAYMOND PEARL	*Biologist*
	FRANK M. SURFACE	*Associate*
	FREMONT L. RUSSELL	*Assistant*
	MAYNIE R. CURTIS	*Assistant*
	WALTER ANDERSON	*Poultryman*
	LOTTIE E. McPHETERS	*Computer*
CHEMISTRY	JAMES M. BARTLETT	*Chemist*
	HERMAN H. HANSON	*Associate*
	JOANNA C. COLCORD	*Assistant*
	JOSEPH F. MERRILL	*Assistant*
ENTOMOLOGY	REX C. GELLERSON	*Inspector*
	EDITH M. PATCH	*Entomologist*
	ALICE W. AVERILL	*Laboratory Assistant*
PLANT PATHOLOGY	WARNER J. MORSE	*Pathologist*
	CHARLES E. LEWIS	*Associate*
	FRANK D. STERRY	*Laboratory Assistant*
ROYDON L. HAMMOND		*Seed Analyst and Photographer*
ANNIE M. SNOW		*Clerk and Stenographer to the Director*
BLANCHE F. POOLER		*Stenographer*
HENRY A. MILLETT		*Meteorological Observer and Janitor*

IMP. BUREAU. ENT
RECD 25 MAY 1909
ANSP

HOMOLOGIES OF THE WING VEINS OF THE APHIDIDÆ, PSYLLIDÆ, ALEURODIDÆ, AND COCCIDÆ.

BY

EDITH M. PATCH.

REPRINTED FROM

ANNALS OF THE ENTOMOLOGICAL SOCIETY OF AMERICA

Volume II. No. 2

COLUMBUS, OHIO
June, 1909

IMP. BUREAU, ENTOM.
RECD 19 APR. 1913
ANSD

University of Maine.

Maine Agricultural Experiment Station

ORONO

BULLETIN No. 171. NOVEMBER, 1909.

THE PINE-LEAF AND THE GREEN-WINGED CHERMES

A bulletin on Maine Chermes now in process of preparation is of technical character and will not be sent to the general mailing list of the Station. The two species discussed in this bulletin, however, are of economic interest in the State and for this reason the following popular account of them is prepared for immediate distribution in Maine. The bulletin on Maine Chermes will not be ready for distribution until next year.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
CHARLES L. JONES, Corinna	*Committee of Board of Trustees*
SAMUEL W. GOULD, Skowhegan	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*

AND THE HEADS AND ASSOCIATES OF STATION DEPARTMENTS

THE STATION STAFF.

ADMINISTRATION	CHARLES D. WOODS, Sc. D	*Director*
	HARRY M. WOODS, A. B.	*Asst. to the Director*
	BLANCHE F. POOLER	*Stenographer*
	RALPH K. JONES, B. S.	*Librarian*
	CHARLES J. DUNN	*Treasurer*
	GRACE M. COLBURN	*Bookkeeper*
BIOLOGY	RAYMOND PEARL, Ph. D	*Biologist*
	FRANK M. SURFACE, Ph. D.	*Associate*
	MAYNIE R. CURTIS, A. M	*Assistant*
	WALTER ANDERSON.	*Poultryman*
	LOTTIE E. McPHETERS.	*Computer*
CHEMISTRY	JAMES M. BARTLETT, M. S.	*Chemist*
	HERMAN H. HANSON, M. S.	*Associate*
	JOSEPH F. MERRILL, B. S.	*Assistant*
	ALBERT G. DURGIN, M. S.	*Assistant*
ENTOMOLOGY	EDITH M. PATCH, B. S.	*Entomologist*
	OSKAR A. JOHANNSEN, Ph. D	*Associate*
	ALICE W. AVERILL	*Laboratory Assistant*
HORTICULTURE	WALTER W. BONNS, B. S.	*Associate*
PLANT PATHOLOGY	WARNER J. MORSE, M. S	*Pathologist*
	CHARLES E. LEWIS, Ph. D.	*Associate*
	JOHN SUMMERS	*Laboratory Assistant*
HIGHMOOR FARM	WELLINGTON SINCLAIR	*Superintendent*
ROYDEN L. HAMMOND		*Seed Analyst and Photographer*
HENRY A. MILLETT		*Meteorological Observer and Janitor*

DUPLICATE
University of Maine

IMP. BUREAU, ENTOM
RECD 19 APR. 1913
AMS

Maine Agricultural Experiment Station

ORONO

BULLETIN No. 172. **DECEMBER, 1909.**

(Distributed March, 1910.)

THE FUNGUS GNATS OF NORTH AMERICA.

Part 1.

CONTENTS.

	PAGE
Introduction	209
Characters	210
Habits and Economic Relations	214
Remedial measures	216
Table of Subfamilies	216
Bolitophilinæ	217
Mycetobiinæ	222
Diadocidiinæ	231
Ceroplatinæ	233
Macrocerinæ	265
Table of measurements	274
Explanation of plates	275

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
CHARLES L. JONES, Corinna	*Committee of Board of Trustees*
SAMUEL W. GOULD, Skowhegan	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*

AND THE HEADS AND ASSOCIATES OF STATION DEPARTMENTS

THE STATION STAFF.

ADMINISTRATION	CHARLES D. WOODS, Sc. D	*Director*
	HARRY M. WOODS, A. B.	*Asst. to the Director*
	BLANCHE F. POOLER	*Stenographer*
	RALPH K. JONES, B. S.	*Librarian*
	CHARLES J. DUNN	*Treasurer*
	GRACE M. COLBURN	*Bookkeeper*
BIOLOGY	RAYMOND PEARL, Ph. D	*Biologist*
	FRANK M. SURFACE, Ph. D.	*Associate*
	MAYNIE R. CURTIS, A. M	*Assistant*
	WALTER ANDERSON.	*Poultryman*
	LOTTIE E. McPHETERS.	*Computer*
CHEMISTRY	JAMES M. BARTLETT, M. S.	*Chemist*
	HERMAN H. HANSON, M. S.	*Associate*
	JOSEPH F. MERRILL, B. S.	*Assistant*
	ALBERT G. DURGIN, M. S.	*Assistant*
ENTOMOLOGY	EDITH M. PATCH, B. S.	*Entomologist*
	OSKAR A. JOHANNSEN, Ph. D	*Associate*
	ALICE W. AVERILL	*Laboratory Assistant*
HORTICULTURE	WALTER W. BONNS, B. S.	*Associate*
PLANT PATHOLOGY	WARNER J. MORSE, M. S	*Pathologist*
	CHARLES E. LEWIS, Ph. D.	*Associate*
	JOHN SUMMERS	*Laboratory Assistant*
HIGHMOOR FARM	WELLINGTON SINCLAIR	*Superintendent*
ROYDEN L. HAMMOND		*Seed Analyst and Photographer*
HENRY A. MILLETT		*Meteorological Observer and Janitor*

IMP. BUREAU, ENTOM.
REC'D 26 MAR. 1913
ANS'D.

University of Maine.

Maine Agricultural Experiment Station

ORONO

BULLETIN No. 173. DECEMBER, 1909.

CHERMES OF MAINE CONIFERS.

CONTENTS.

	PAGE
Chermes pinifoliæ	277
Chermes abietis	290
Chermes lariciatus	294
Chermes consolidatus	297
Chermes floccus	299
Chermes similis	301
Chermes pinicorticis	303

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL

PRESIDENT GEORGE E. FELLOWS	*President*
DIRECTOR CHARLES D. WOODS	*Secretary*
JOHN A. ROBERTS, Norway	*Committee of Board of Trustees*
CHARLES L. JONES, Corinna	*Committee of Board of Trustees*
SAMUEL W. GOULD, Skowhegan	*Committee of Board of Trustees*
AUGUSTUS W. GILMAN, Foxcroft	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn	*State Grange*
CHARLES S. POPE, Manchester	*State Pomological Society*
RUTILLUS ALDEN, Winthrop	*State Dairymen's Association*

AND THE HEADS AND ASSOCIATES OF STATION DEPARTMENTS

THE STATION STAFF.

ADMINISTRATION	CHARLES D. WOODS, Sc. D	*Director*
	HARRY M. WOODS, A. B.	*Asst. to the Director*
	BLANCHE F. POOLER	*Stenographer*
	RALPH K. JONES, B. S.	*Librarian*
	CHARLES J. DUNN	*Treasurer*
	GRACE M. COLBURN	*Bookkeeper*
BIOLOGY	RAYMOND PEARL, Ph. D	*Biologist*
	FRANK M. SURFACE, Ph. D.	*Associate*
	MAYNIE R. CURTIS, A. M	*Assistant*
	WALTER ANDERSON.	*Poultryman*
	LOTTIE E. McPHETERS.	*Computer*
CHEMISTRY	JAMES M. BARTLETT, M. S.	*Chemist*
	HERMAN H. HANSON, M. S.	*Associate*
	JOSEPH F. MERRILL, B. S.	*Assistant*
	ALBERT G. DURGIN, M. S.	*Assistant*
ENTOMOLOGY	EDITH M. PATCH, B. S.	*Entomologist*
	OSKAR A. JOHANNSEN, Ph. D	*Associate*
	ALICE W. AVERILL	*Laboratory Assistant*
HORTICULTURE	WALTER W. BONNS, B. S.	*Associate*
PLANT PATHOLOGY	WARNER J. MORSE, M. S	*Pathologist*
	CHARLES E. LEWIS, Ph. D.	*Associate*
	JOHN SUMMERS	*Laboratory Assistant*
HIGHMOOR FARM	WELLINGTON SINCLAIR	*Superintendent*
ROYDEN L. HAMMOND		*Seed Analyst and Photographer*
HENRY A. MILLETT		*Meteorological Observer and Janitor*

MAINE AGRICULTURAL EXPERIMENT STATION

Entomological Paper No. 40.

Chermes of Maine spruces. By Edith M. Patch. Psyche Dec. 1909, pp. 136, 137. Brief descriptions and notes on the following species:-Chermes pinifoliae Fitch, C. abietis Linn, C. similis Gillette, C. floccus n.sp., C. consolidatus n.sp. C. lariciatus n.sp.

Through a mistake the Experiment Station at Orono were not supplied with reprints of this paper and consequently the Bureau has not been able to procure a copy.

E.J.S.(14.VII.14)